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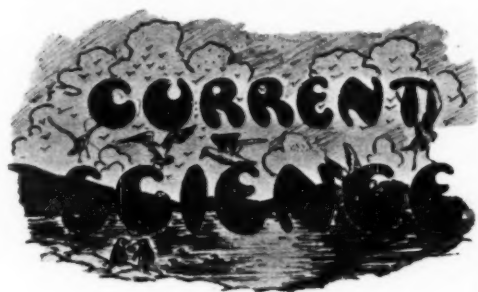
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## Disarmament.

JUDGING from press notes and preliminary talks of the ministers, we infer that as soon as Germany is induced to join the other Powers, the more serious discussions about disarmament in the Bureau of the Geneva Conference will relate to the limitations and certain alterations in the character of the implements of war. One may reasonably doubt whether these proposals alone have the power in themselves to mitigate the horrors of hostilities, if, unfortunately, in spite of the best endeavours to the contrary, they should break out. Will men become so civilized and spiritually perfected as to employ love and self-sacrifice instead of hatred and destruction in the settlement of all international differences? This is by no means an idle and fantastic proposition, but at bottom a biological question and on the answer we give to it must depend the prospect of the future of our race. It is obvious that scientific ingenuity will make up for restriction in the number of weapons, their change of calibre, the reduction in the tonnage of fighting vessels and aeroplanes, by the intensity, range and rapidity of their powers of annihilation. Let us not make the mistake of deluding ourselves into the belief that the sense of war-weariness which has overtaken Europe since 1919 is synonymous with a reformed mind yearning for peace and goodwill. These are no doubt the very things for which we labour, but the road we are treading may not possibly lead to them. Even a purely material civilization need not necessarily be hostile to the existence of spirituality among the people without which universal peace, amity and concord in human relations and affairs can only be conventional.

The progress of civilization has nearly succeeded in replacing the dispensation which enjoins us to love our enemies, to bless them that curse us, to do good to them that hate us and to pray for those who despitefully use us and persecute us by the Gospel of international loaves and fishes. We are familiar with the public pronouncements of politicians at the time of the Great War that the only justification of their entering it was the vindication of the honour of international pacts and treaties and the protection of civilization which the conflict had threatened to submerge. Speaking in the House of Commons in 1923, Mr. Baldwin referred to

this civilization thus, "I have often thought, with reference to the late war that one of the most terrible effects of it,—possibly a double effect—has been that it has shown the whole world how thin is the crust of civilization on which this generation is walking." It is quite obvious that a machine civilization with its concomitants, overproduction, unemployment, swollen population, economic competition, bitter vicissitudes of public credit, must inevitably lead to frequent disputes and occasional open hostilities. The scientific discoveries and the inventions of the nineteenth century which formed the basis of the industrial revolution,—perhaps the most impressive phenomenon of modern times,—were welcomed in the hope of their exerting a great humanizing influence on man, but the war demonstrated that primitive barbarism was only latent and could be roused into perfect savagery at the first blast of the trumpet. In the pursuit of discoveries, we stuck fast to the laboratory and forgot the Ten Commandments and these scientific achievements while they tended to improve the material comforts and life-saving devices on the one hand also helped on the other to perfect the means of destroying life. It is true that we have made great strides in our knowledge of the secrets of nature, and in a great measure we have harnessed her forces for the service of man, but his moral evolution has not kept pace with the progress of industrialism and we are now paying the penalty for not keeping the equipoise between the advancement of spirituality and that of machinery. The main criticism against our civilization by the artistic disciples of Ruskin and Morris is its tendency to standardise everything including our public taste and the working of the mind and to interpret nationalism in terms of natural laws without reference to those Evangelical doctrines which promised the blessings of peace. It is just as futile to endeavour to cure the acquisitive spirit of man by limiting the opportunities of competitive ambition as to eliminate his fighting instincts by imposing restrictions on the weapons of warfare.

The darkest hour in the history of our civilization was reached in 1917 and in 1919 a great opportunity occurred when through a determined co-operative effort of all the nations, the course of the whole civilization might have been deflected into a new channel promising peace and goodwill.

There were two courses open to the Powers to strike a new path, not by any means chimerical, but only demanding the will to see and to sacrifice. The victorious allies, had they extended the hand of fellowship to the beaten enemies and had said that they would forget all the happenings of War, provided that the expenditure on armaments were given up on both sides, would have placed human progress on a new and different plane. But knowing human nature to be what it is, this is clearly an impossible and impracticable suggestion. We may be civilized to the point of wearisomeness in the language of Kant, but our minds are not sufficiently spiritualized to rise to the apocalyptic heights from which visions of a new world are to be seen, visions of a new race of mankind and a new order of things which such a Christian course might have produced. Perhaps the second procedure which is less extravagant but equally difficult to pursue might have been considered practical, and, had it been adopted, the world would not have had to pass through the post-war travails to which she is subject to-day. The problems of reparation, war debts, disarmament and economic rehabilitation of Europe might have been referred to a Commission composed of a humanist, a financier and an engineer belonging to the neutral Powers in whose integrity and judgment the belligerents might have had unbounded confidence and by whose decisions they would have unhesitatingly abided. The expenditure of the Commission could have been defrayed by the allies and the enemies jointly and till the submission of the report of these experts, the Powers might have agreed to suspend all their activities of repairing and strengthening their armaments and to resume their normal pre-war economic relations. The Commission would have been instructed to submit their report fifteen years after the date of their appointment, a period of time in which our feelings of anger and vindictiveness and our memory of the atrocities perpetrated during the progress of the War, may have been softened or partially forgotten so that the Powers would have been in a fit position to examine the findings of the Committee with some measure of calm and collected mind in a peaceful atmosphere. Having in the meantime built up their economic and financial resources at least to some extent, the belligerent nations would have been in a position to



bear and fulfil their respective financial obligations. Psychologically it is uncharitable to expect the victorious allies smarting under a sense of grievous wrongs, to deliberate at Versailles immediately after the War in a dispassionate and Christian spirit all the problems arising out of the stupendous conflict in which the geographical boundaries were torn and in which there was reckless waste of men and money. It was in 1919 that civilization and religion deserted the nations and we were too blinded by the animal passions to read the teachings of both, and unconsciously affirmed the doctrine of Dean Inge that human progress is not vertical but moves in a vicious circle. But better things might have occurred and it is tempting to dream of a new world, in which reason, conciliation and love will be the ruling factors of the life of mankind.

The problems of disarmament, war-debts and reparations form the three strands of the international skein and the Powers find it difficult to discuss any one of them without reference to the other two. They have their roots deep in the social and political structure of Europe and their satisfactory solution must necessarily involve a more searching examination of this tangled fabric. The chief object of "notes" and "consultations" about the first two questions is the insistence of the United States on the stoppage of expenditure on armaments on the part of her debtors and the demand that the amount should be devoted to the payment of their dues. The plea of the European Powers is that on account of the distracted state of their finance and trade they desire the postponement of the payment of their debts so as to enable them to discuss further possibilities of arranging for payments more satisfactorily to themselves. Britain has cancelled sixty per cent of the dues which her debtors owe to her and she has to pay nearly 200 millions more than her allies. France has renounced her claims on German reparations and having to devote the greater part of her revenues for renovating her industries, pleads inability to meet the demands made on her. America complains that in order to maintain her armament level with the European Powers she has to spend without receiving her dues. All the countries suffer from economic and financial depression besides having to face the problem of unemployment on an unprecedented scale. It seems to us that the way out of this tangle is that the European Powers should declare that they would sus-

pend further expenditure on armaments for the next fifteen years and divert the funds thus released for the purpose of rebuilding their disordered trade and broken finance and for social reconstruction and ask for a moratorium for this period. At the end of this period when trade and finances have improved, the issues of war-debts can be discussed in a more favourable atmosphere and with greater chances of a satisfactory settlement. A courageous policy such as this is sure to appeal to the better mind of the Americans who still pray daily, 'Forgive us our debts, as we forgive our debtors' as an evidence of a genuine desire on the part of the European nations to set their houses in order and to establish peaceful settlement, making due provision in the meantime to meet their obligations to the fullest extent. It is inconceivable that when the whole spinal system of Europe is paralysed, any one nation will, during this period, become truculent or aggressive and were it to show such symptoms all the other nations with one common will should exert a complete economic blockade on the offending Power and this, more than an appeal to arms, is calculated to bring it to reason. Such a warlike nation should be made to forfeit automatically the benefits of grace.

The problem of disarmament as we envisage it, is wider than a mere question of restriction and it should include in its programme the exploration of the possibilities of ultimately establishing permanent universal peace. Other instruments than war should be discovered for the settlement of economic or racial differences if such should arise at all. We do not believe that war is necessary to comb out the unfit from among us or to solve the problem of unemployment and to raise the national efficiency for which we have to seek the assistance of the infant science eugenics. We are aware that immediate and complete abolition of armaments though necessary in the interests of wider humanity may not be a practical suggestion but that it should be the final objective for the preservation and progress of our race, we are convinced. If the governments of the five Powers should for any reasons fail to achieve this supremely desirable end, perhaps it will be the task of the people sooner or later to enforce it. In discussing the various plans made by the European and American governments for assisting the progress of disarmament and peace, the ministers will, it is hoped, bear in

mind Mr. Baldwin's grave warning recently given about the terrors of aerial war. The man in the street ought to realize thoroughly the devastating powers of the gas and disease bombs with which a couple of aeroplanes may utterly annihilate the civil inhabitants of a populous city so that in aerial warfare both the belligerents are in grim danger of total extinction. If our civilization cannot dispense with armaments for the purpose of maintaining international concord or for the purpose of protection from foreign aggression, the only alternative is to embark on the policy of increasing and perfecting our lethal weapons in the vain hope that neighbours who live in *terrible dread* of each other's powers of destruction may live in peace because either is afraid to infringe it for fear of disastrous consequences. We would then be having a balance of peace such as is preserved among the fierce animals whose best protection is their savage ferocity and those endowed with neither strength nor courage will have recourse to various adaptive modifications to escape subjugation or total slaughter. The teachings of religion, the ideals of progress and the very foundations of our social organization must refute the suggestion that we cannot, with a supreme effort of co-ordinate determination on the part of all the civilized races of mankind, discover and devise methods of settling our disputes in a more humane manner than by clash of arms and that we cannot live in mutual sympathy and love without the necessity of armament as an instrument of peace. So long as the tiger in man is not replaced by a spirit of true Christian meekness we remain in usurpation of the earth and not in legitimate inheritance.

The essence of modern civilization is the subordination of religious values to economism and its outward expression is that while it preserves the fighting instincts of man it blunts the keenness of his praying faculty. Our present economic relations are so delicate and complex that

the violation of any one of their laws must inevitably invoke the aid of armaments for the restoration of the disturbed balance,—a process which always worsens the old situation. "It is not certain that there has been much change in our intellectual and moral endowments since Pithecanthropus dropped the first half of his name." The reason for this accusation of our progress is that current schemes aim at reforming and improving the social organization as a whole, neglecting the individuals who compose it and the task of perfecting the individuals now becomes the province of science, especially of the biological science of eugenics. Perhaps a scientific civilization which, it is hoped, will secure "the passage of a less desirable state of life to a more desirable", may succeed in producing an international mind setting up qualitative values for checking our estimates of good or evil in the social, economic, political and cultural relations. In the meantime the greatest need is a vivid and sincere recognition of the fact that the spirit of militarism, still haunting the public mind of Europe should not be permitted any longer to vitiate even unconsciously the noblest efforts of her ministers to establish mutual concord and trustfulness on a basis of a real and permanent international partnership and to secure and fortify the national rights by the purity and elevation of a stern public opinion. Mr. Baldwin once said that there are "four words of one syllable, each of which contains the salvation of this country and of the whole world and they are 'Faith', 'Hope', 'Love' and 'Work'." It may sound almost like a Utopian idea to suggest the substitution of these monosyllabic words as instruments of international negotiations for the establishment of peace more than "Disarmament", "Reparations" and "War Indemnities". This idea, though it may not be realized in the near future, should not be permitted to remain long beyond the range and grasp of Christian temper and collective statesmanship.

## Marine Biological Research in India.

By Lt.-Col. R. B. Seymour-Sewell, M.A., SC.D., F.Z.S., F.A.S.B., I.M.S.,

Director, Zoological Survey of India, Calcutta.

"THE outstanding fact about India is the poverty of the people and the prospect of this becoming steadily worse with the enormous growth of the population until, failing wars or pestilence, starvation itself steps in to adjust the balance. No one is doing anything about this." So writes Mr. Arthur Moore in his article on "Beloved India" in the *Fortnightly Review* of October last; and he goes on to add that "it ought to be possible to devise a great Indian plan . . . to organize her (India's) agriculture and her other industries, so that her people shall get the benefit in good wages and a higher standard of living and increased consumption of her own products."

To anyone who has had any experience of Indian fisheries and who has been able to compare the conditions that exist in India with those that pertain in almost every other part of the world, it is abundantly clear that the marine resources of India are at the present time almost untouched and that an almost inexhaustible supply of cheap and wholesome food, as well as of other marine products that form the basis of trades, such as button making, etc., remains for the most part unexplored and unexploited. The occupations of fishing or dealing with fish is regarded throughout India as one to be carried on only by low caste people and as a result the entire fisheries are left in the hands of those who are not in a position, either intellectually or financially, to develop them, while in every main centre the actual marketing of these supplies has become concentrated in a close "ring", part of whose system is to see that the actual fishermen are kept in a continued state of debt on account of funds advanced to them by the members of this "ring" for the purchase of gear, etc., and who frustrate any attempt to increase the supply of fish by a refusal to purchase the catches made by any organization that is not under their immediate control. From time to time abortive experiments in marine fishery work have been carried out by certain Provincial Governments, such as the investigations of the Bengal Marine Fisheries by the "Golden Crown" in 1908-09 and those of the Bombay coast by the "William Carrick" in 1921-22,

and in each case the conclusion reached was that there is an ample supply of fish in Indian waters that could be caught by such trawling methods but that to be a commercial success much greater facilities for the distribution and sale of the catches would be necessary. As Dr. Amirthalingham has pointed out in his letter to *Current Science* (Nov. 1932) it by no means follows that the methods of catching fish that are at the present day employed in European waters will prove to be most suitable or successful in Indian Seas, and one line of research that is much needed is the scientific investigation of those methods that have been employed in tropical waters in other parts of the world, especially those in use among the Japanese and Chinese fishermen.

Such investigations clearly cannot be undertaken by the fishermen themselves and although it may be possible in the future to educate the members of the fish "rings" in the large ports of India sufficiently to enable them to recognize that improved fishing methods will lead to increased markets and, therefore, to increased profits, and thus to enlist their financial support for such marine investigations, as has been done in England and other countries, it is clear that in the main one must look to Government aid for these purposes. Unfortunately at the present time the Governments, both Provincial and Imperial, appear to be far more interested in Agriculture than in Fisheries and, although in the past these two subjects have been administered by the same department, so little attention has been paid to the latter that, with the single exception of Madras, there is not a single province with a Fishery Department worthy of the name. Indeed, in certain provinces there has been a very retrograde movement, as, for example, in Bengal, where in 1915 there was a Fishery Department of Bengal, Bihar and Orissa employing a Deputy Director, two Superintendents and one Assistant, whereas there is at the present only a single Fishery Officer; and other provinces appear to be in like case.

If ever the Fisheries are to be improved and placed on a proper basis, it is clear that scientific research on both the fauna itself

and the conditions under which the fauna is living is the first essential. In 1920 a Committee was appointed by the British Association for the Advancement of Science to consider the question of Marine Biological Research in India and they reached the conclusion that it was only by the erection of a Marine Biological Station that any considerable improvement in our knowledge could be made, while at the same time they drew attention to the need of providing increased facilities for the biological work of the Surgeon-Naturalist on board the R.I.M.S. "Investigator". As regards this latter recommendation it may be pointed out that, far from increased facilities being granted, on the transfer of Lieut.-Colonel (then Major) R. B. Seymour-Sewell, I.M.S., from this post to that of Director of the Zoological Survey of India, the post of Surgeon-Naturalist was held by Major R. W. G. Hingston, I.M.S., during one survey season, from October 1925 to April 1926, after which he proceeded on leave and later retired from the service and no scientist has ever since been appointed to succeed him. There has, therefore, been a complete cessation of this branch of study, and indeed at one time there was considerable danger of the post itself being actually abolished by the Government, who appeared to be under the impression that the work of the Surgeon-Naturalist was of neither actual nor potential value. As no suitable scientist could, under present conditions, be provided by the Indian Medical Service, the Secretary of State agreed to the post being transferred to the Zoological Survey of India but so far no officer has been appointed, nor is there any likelihood that one will be appointed in the near future owing to financial difficulties. Thus this line of scientific marine research has come to an end at any rate for the time being.

In 1920 a detailed scheme for the erection of a Marine Biological Station was submitted to the Government of India by Dr. S. W. Kemp, who was then the Superintendent of the Zoological Survey of India and who had been deputed by the Secretary of State to investigate the Marine Biological Stations of Europe during a period of his leave. A similar proposal for the erection of a Marine Biological Station under the Madras Fishery Department was put forward in the following year by Mr. Whitehouse, of the Central Training College, Lahore. Dr. Kemp's proposal was for the erection of a station in Port Blair in the Andaman Islands, where

the fauna is known to be particularly rich and where, owing to the geographical position of the islands, oceanic conditions are present; but in 1926 the proposed site of this station was changed to Karachi, as it was felt that Port Blair was too inaccessible and that Karachi would offer a more accessible site to which advanced students from all the Universities of Northern India could easily come and where, further, the scientific staff of the station would be in close touch with fishery work and commercial fishing. Although at one time it appeared possible that the Government would erect this station and full plans were drawn up and a suitable site allocated, their actual sanction was postponed year after year until the present financial position of the Government renders its fulfilment beyond the bounds of hope.

It is, therefore, with all the greater satisfaction that one welcomes the suggestion made by Dr. S. B. Setna that a Marine Biological Station should be erected in Bombay; and one sincerely hopes that he will be enabled to raise sufficient funds from among the far-sighted inhabitants of the city. The work of such a station falls into two categories, namely, the purely scientific and educational side, and the economic aspect; and of these the first is, at any rate at the outset, by far the more important, since no real improvement of the fisheries themselves can be made without a scientific basis and the data required for such a basis may take several years to obtain, especially in such a country as India, where the number of trained zoologists is comparatively small and where there are such marked differences in the conditions under which the fauna is living along the extended coast line of the Indian Peninsula. As has been pointed out by Kofoid in his *Handbook to the Biological Stations of Europe*, the great research stations of that continent "are supported largely and often almost exclusively (except in Great Britain) by State and local funds. This is made possible in European countries by the recognition on the part of the State of the relation of research to higher education in biological sciences." One of the main questions that must be faced if a Marine Biological Station is to be established is the provision of funds for its upkeep, when it has actually been established; for it is clear that it would be perfectly useless to go to the expense of building such a station, if in a year or two



it would have to be closed down for lack of financial support. In the selection of an appropriate site for such a station one must of necessity take this factor into consideration, as well as others such as the abundance and variety of the local fauna and flora, the ease of access, the varied types of environment, the tidal amplitude, climatic conditions and, last but by no means the least, the purity and salinity of the water; and this last consideration will present very considerable difficulty in such a port as Bombay. On the other hand, it is only in such a centre, where there is a large and well-educated public and where in this instance there is the added advantage of having in the city such a well-known and widely influential scientific society as the Bombay Natural History Society, that there would be any probability of being able to raise sufficient support locally to ensure the maintenance of the station. Should the station be started, there is little doubt that many of the Universities would contribute towards its upkeep in the same manner as is done in Europe and other countries by renting "tables", to which advanced students can be appointed for the purpose of carrying on research; other lines along which additional funds may be

obtainable are by the supply of material to colleges for the practical instruction of classes within the Universities themselves, but in this case the new station will have as a rival the already established branch of the Madras Fishery Department, that now supplies most of the wants of the Indian Colleges. Finally there will doubtless be a large number of visitors, both educated and uneducated, the latter especially during the pilgrim season, who will pay to come and see the Aquarium, that must necessarily form a part of such a station; but in this connection it must be remembered that the admission fee must be kept as small as possible or many of the poorer people will not be able to afford it. From a careful consideration of the whole matter it seems that only one conclusion regarding the financial outlook is possible and that is that such a station cannot, at any rate at first, be self-supporting and it is doubtful whether it would ever be, even after it had succeeded in proving beneficial to the fisheries of India and, therefore, might naturally expect to obtain some financial support from those who in the future will be exploiting the fisheries of India for their own private or public profit.

### Sewage Farming in India.

By Dr. V. Subrahmanyam, D.Sc., F.I.C.,

*Professor of Biochemistry, Indian Institute of Science.*

**ALTHOUGH** a considerable amount of highly valuable research has been carried out on land disposal of sewage, yet the available scientific information with regard to the utilization of sewage in agricultural practice is comparatively limited. As the result of this and the general impression that the problems connected with sewage belong to the domain of sanitary science, we find hardly any mention of sewage farming in books on agriculture. On the other hand, utilization of sewage or sullage, as the case may be, plays a very large part in agricultural practice, particularly in the Far East, and, in view of the valuable fertilizing ingredients present in it, deserves to be even more widely adopted than in the past. It is no doubt true that popular sentiment has generally been against the use of sewage, but there is, as yet, no sound scientific evidence to support such an impression: in fact, the remarkable success

achieved on certain experimental farms and by several private individuals, particularly market gardeners, would clearly indicate that, with judicious handling, sewage would be the cheapest and, at the same time, one of the best fertilizers used by man. In this direction much valuable information is available from the reports of some of the sewage farms in India and the object of the present contribution is to present a brief account thereof and to draw attention to certain lines along which further scientific work has to be carried out to place sewage farming on sound, economic and, at the same time, hygienic basis.

There are several sewage farms in India and some of them are very old, dating back to the middle of last century. Unfortunately, most of them do not either possess proper records or have not been carefully maintained, so that the considerable amount of what might have been valuable information,

is now lost. Although most of the farms referred to in the present paper were started within the past two decades, they yet possess the advantage of having been run along scientific lines, so that the information provided by them would be of great practical importance.

The effluent farm near Poona was started in 1918 and now covers an area of over 63 acres. The effluent is derived from septic tanks and used for irrigation after suitable dilution with canal water so as to provide about 300 lbs. of nitrogen per acre, in the course of one year. Among the experiments carried out on that farm may be mentioned: (a) effect of quantity of nitrogen applied as effluent on the out-turn of sugarcane, (b) comparison of sewage effluent with other fertilizers, (c) response of different varieties of cane to irrigation with effluent, (d) effects of season, frequency of watering, and rotation with other crops on yield and quality of cane, and (e) response of various market garden crops, fruit trees, betel vine, etc., to sewage irrigation. The observations which are spread over several years show that, by judicious irrigation with the effluent, very heavy yields of cane, often amounting to double that obtained by water irrigation can be obtained. It is profitable to reduce the depth of water from 140" as generally used by the ryot to 80". Except in shallow soils the best results are obtained by watering at 10-day intervals. Sugarcane will not ripen unless the effluent is withheld for three months before harvest, so that, when irrigating sugarcane, it would be necessary to run duplicatory channels with water. Application of even concentrated doses of effluent does not have any appreciable effect on the soil or on most of the crops that were tried. Sugarcane responds to increasing dosage of nitrogen up to a maximum of about 300 lbs. per acre. The effluent is in no way inferior to the other manures commonly used for sugarcane. Legumes are the best rotation crops for sugarcane and bajri is superior to jowari. With proper management, a variety of market garden crops can be raised on sewage with profit. With the exception of grape vine all the fruit trees thrive well and gave high yields. Betel vine flourished on effluent and brought at least as high returns as well irrigation. All fodder crops grew well on effluent mixture and gave much higher yields than those obtained by ordinary irrigation. (Ingulis, *Bombay, P. W. Dept. Tech. Paper*, No. 17, 1927.)

The foregoing observations are highly suggestive, but further work is needed to place them on sound scientific basis. The conductivity method of measuring nitrogen is highly ingenious, but the results do not differentiate between the effect due to the small quantities of nitrogen thus measured and that caused by much larger quantities of other electrolytes present together with it. The statement that neither the soil nor the plants raised thereon is adversely affected by continued application of concentrated sewage is rather bold and will not be supported by other observers. Further systematic work on market garden crops, fruits and fodder crops is required before any definite conclusion could be drawn.

The sewage farm attached to the Indian Institute of Science, Bangalore, was started by Prof. G. J. Fowler in 1922 and has since been in continuous service. The researches conducted thereat relate to: (a) the effect of continuous sewage treatment on soil conditions, (b) response of different market gardens, fruit, grain and fodder crops to sewage irrigation, (c) relative fertilizing values of different types of sewage sludges, raw sewage, effluents from activated sludge and septic tanks and dilutions thereof, (d) physiological response of crops raised on sewage, (e) study of plant diseases associated with sewage farming, and (f) the nature of the morphological and physiological transformations that attend the pathogenic and putrefactive organisms normally present in sewage under conditions relating to sewage farming.

The results of the investigations show that under continuous irrigation with moderate quantities of sewage the electrolytes tend to increase though the organic matter does not persist: even before reaching the stage of sewage sickness the soil attains a condition when either irrigation with water or a few showers of rain or fallowing becomes necessary prior to resuming cultivation operations. Generally, leaf crops respond better to sewage than grain or fruit crops but even then frequent fallowing and rotation of crops is necessary to maintain high yields. The fertilizing value of activated sludge is higher than that of the chemically precipitated one, but in the latter case it is difficult to differentiate between the effect due to the sludge and that to the chemical precipitant: it is distinctly higher than that of farmyard manure or any similar synthetic preparation. The effluent from septic tank is richer than

that from activated sludge but it has to be diluted about 3 times with water before it can be safely applied to farm crops in general: even activated sludge effluent proves to be too rich in certain seasons and could be profitably used only after dilution. Comparative pot and plot culture trials with grain and fodder crops have shown that, when irrigated with diluted effluent, plant growth is quite normal, but the yields are limited by the organic matter and phosphate contents of the soil. With regulated irrigation and adequate drainage the crops raised on previously treated and diluted sewage are perfectly healthy but under other conditions, various difficulties are encountered. Excessive sewage leads to crop lodging: inadequate drainage or failure to fallow at frequent intervals discourages plant development and leads to a variety of diseases, particularly root and stem rots: untreated sewage would often appear to contain insect pests which tend to destroy many of the crops. The fate of pathogenic and putrefactive organisms generally associated with sewage is still obscure as they could not be readily fallowed in the soil, but further work is in progress to elucidate the position.

The researches at Bangalore would appear to form a useful complement to those at Poona; but they still lack precision and more quantitative data are required to further substantiate the conclusions stated above.

Valuable work has been done by Temple and his colleagues at Jamshedpur where a big sewage farm is being maintained successfully on wet activated sludge alone. In the course of their experiments they found that "the plot irrigated with clean water and not manured produced green fodder crop at the rate 700 lbs. per acre. Another irrigated with activated manure recommended by the Poona Agricultural College produced 15,000 lbs. per acre; and a similar plot, treated with the same amount of nitrogen as in the former case, in activated sludge, produced 30,000 lbs. per acre." [Temple, F. C., *Trans. Inst. Conf. San. Eng.* (London), 1924, 102.]

The above observations are highly suggestive but it is doubtful if they could be applied to different soil conditions: the heavier types, in particular, do not permit of ready drainage and would soon get sewage sick if plied with wet sludge. Moreover, activated sludge is not purified sewage and would readily undergo septic action wherever it is allowed to stagnate.

The sewage farm at Dacca was under the management of the Public Health Department of the Government of Bengal between 1923 and 1930. During that period considerable amount of fundamental work was carried out investigating the best means of utilization in dry as well as wet weather. During the dry season fodder as well as market garden crops thrive on sewage effluent but the latter have not, so far, proved quite paying. During the flood season, when the land is too wet to irrigate, the effluent is discharged into large dilution tanks, 14 acres in extent, and thus disposed of.

The experimental sullage farm at Lyallpur, Punjab, was put into operation in 1917 and was under continuous observation till 1924. A number of useful data were collected, but owing to the uneven fertility of the experimental area and the rapidly fluctuating nitrogen content of the soil the results could not be regarded as being quantitative. Among the crops experimented with, green fodders, vegetables, and sugarcane gave the most satisfactory response; maize and oats did fairly well but wheat tended to lodge and underground vegetables cracked and burst owing to excessive enrichment of the soil (Lander, P. E., *Agric. Res. Inst., Pusa, Bull. No. 157, 1925*).

Benefitting by the experiences of Poona and Bangalore, the Drainage Department of Hyderabad, Deccan, has recently (1931) launched on a fairly large scheme of irrigation with the effluent discharged from the septic tanks treating the sewage of the City of Hyderabad. An area of 3000 acres has been set aside for the irrigation but so far, only about 1000 have been brought under the plough. An experimental farm covering about 100 acres has also been started and the requirements of crops like sugarcane, perennial fodder, fruits and vegetables investigated.

The Municipal Farm of the City of Bangalore is being managed by the Horticultural Department of the State. The Mysore City farm is administered by the Municipality but is under the technical supervision of the Public Health and the Agricultural Departments. A number of crops—particularly green fodder and vegetables—are being raised with success. A unique feature in both the above centres is the avidity with which enterprising private growers utilize all available supply of sewage.

In the province of Madras, sullage is being used, whenever possible, for permanent

grasses and fodder crops but, so far, no systematic work has been undertaken on the utilization of sewage for raising grain or remunerative crops. An activated sludge plant has recently been installed at the Agricultural Research Institute, Coimbatore, and experiments utilizing the sludge as manure and effluent for irrigating remunerative crops have been undertaken.

Interesting experiments on the relative values of effluents and sludges from sewage treated in different ways are in progress in the farm attached to the City of Nagpur. Mention should also be made of the work carried out at Nasik, Indore and different other cities, but the present space is hardly adequate to do justice to them all.

Although much useful headway has already been made, a great deal yet remains to be done. The system of irrigation has still to be improved so as to secure maximum benefit from all the plant nutrients present in sewage. The dangers of crop lodging have to be avoided without sacrificing

the fertilizing value of nitrogen. The conditions relating to the application of sewage to grain and remunerative crops have yet to be standardized: crop requirements of ingredients other than those present in sewage have to be determined and judiciously applied. The quality of crops raised on sewage has to be systematically investigated with particular reference to taste, keeping and nutritive value. The transformations attending the various pathogenic and putrefactive organisms normally present in sewage have to be carefully determined and the relation of those organisms or the products of their metabolism to plant development, animal health and human welfare elucidated. In view of their importance in relation to both agriculture and public health, it is to be hoped that the above and related problems will soon receive the necessary attention at the hands of the workers concerned and that sewage farming will, before long, be placed on a sound economic and hygienic basis.

### A Note on the Expanding Universe.

By Prof. A. C. Banerji, M.A., M.Sc., F.R.A.S., *Allahabad University.*

EDDINGTON has shown that Einstein world is unstable and that any small disturbance would start it expanding or contracting. He has also shown that conversion of matter into radiation tends to retard expansion (*M.N.R.A.S.*, May 1930), whereas McVittie has found in his revised investigation that the effect of gradual condensation of matter into galaxies would tend to cause expansion (*M.N.R.A.S.*, Jan. 1931). The shift, towards the red, of the spectral lines of the light emitted by very remote objects like spiral nebulae is responsible for the assumption that these bodies are receding from us, and consequently the Universe is expanding. Hubble and Humason formulated from available data the following velocity-distance relation of the receding object within an error of 10%,

$$\text{Velocity} = \frac{\text{Distance (par-secs.)}}{1790}$$

(in km. per sec.)

(*Astrophysical Journal*, Vol. LXXIV, 1931.)

This corresponds to a velocity of 558 km. per sec., per million par-secs. This is equivalent to a velocity of about  $\frac{1}{1800}$  of the velocity of light for a distance of a

million light-years. Calculating on this basis we see that a nebula which has receded to a distance of 1,800 million light-years ought to have the limiting velocity equal to that of light, and the limiting volume will then be nearly three times that of the Einstein's static Universe, which is supposed to have a radius of about 1,200 million light-years. When the Universe has expanded to this limit, several difficulties arise and it becomes a legitimate question to ask as to what would now happen to the Universe. Dynamically, matter cannot have any velocity greater than the velocity of light. But it has, on the other hand, been suggested that matter possessing velocity greater than that of light belongs to a different disconnected world which cannot bear any physical relation to us. This is only a suggestion and its validity or otherwise can be determined only by subsequent work. It is also possible to make another suggestion. If, due to any causes (of which we have so far no evidence), as soon as the particles of the nebula attain the velocity of light they are transformed into radiation, then such a process, as shown by Eddington, would check expansion, and the Universe may



subsequently begin to contract. Now, moreover, mass (relative-mass) of a receding nebula becomes infinite when in the limit it attains the velocity of light, and consequently the total mass of the Universe becomes infinite. When nearing this limit the mass of the Universe increases very rapidly, and the structure of the Universe would then be like an expanding hollow shell with increasingly dense matter on the surface and comparatively little mass inside. One may ask if the conservation of mass (relative-mass) is an invariable law of Nature (Eddington, *The Mathematical Theory of Relativity*, p. 33), then how has this increase in mass been brought about? Or, shall we have to say that the mass also is not conserved? One is confronted with a similar difficulty in the theory of Special Relativity. Suppose we have two particles of rest masses  $M$  and  $M'$  (with respect to each other) moving relative to each other, then we can calculate the total mass of the system in two different ways. If  $M$  be assumed to be at rest and  $M'$  moving with a velocity  $V$ , then the mass of the latter changes and becomes

$$\frac{M'}{\sqrt{1 - \frac{V^2}{c^2}}}$$

and the total mass of the system becomes

$$M + \frac{M'}{\sqrt{1 - \frac{V^2}{c^2}}}$$

On the other hand, if we suppose  $M'$  to be at rest and  $M$  to be moving with velocity  $-V$ , then the total mass of the system comes

$$\text{out to be } M' + \frac{M}{\sqrt{1 - \frac{V^2}{c^2}}}$$

the second. These two expressions for the total mass are different. In the first case the total energy of the system (apart from interaction energy which, if any, will be the same in both the cases) is

$$Mc^2 + \frac{M'^2 c^2}{\sqrt{1 - \frac{V^2}{c^2}}} = Mc^2 + M'^2 c^2 + \frac{1}{2} M' V^2$$

neglecting terms of higher orders. In the second case the total energy (apart from interaction energy) neglecting terms of higher orders, comes out to be

$$M'c^2 + Mc^2 + \frac{1}{2} M V^2.$$

These two are different and the law of conservation seems to fail. It is well known that the Principle of Relativity has been developed from the motion of one body, and no way has yet been found for treating the motion of two bodies moving relatively to

each other and possessing inter-action energy. The necessity for development along these lines is very great because, without some guiding light about this problem, it is not possible to make any progress in the study of the Universe as a whole, as has been pointed out in this note, and also in the Study of Nuclear Physics.

The formula for the rate of the expansion

$$\text{can be put as } \frac{da}{dt} = \sqrt{\frac{1}{3} a^2 \lambda - 1 + \frac{4M}{3\pi a}},$$

where  $M$  is the mass,  $a$  is the radius of the Universe at any time and  $\lambda$  is the cosmical constant in Einstein's gravitational equation. (*M.N.R.A.S.*, May 1930.)

$$\text{When } M \rightarrow \infty, \frac{da}{dt} \rightarrow \infty.$$

As matter cannot have any velocity greater than the velocity of light, the above equation breaks down as soon as the receding nebula attains the velocity of light. It has been calculated that the radius of the Universe (Einstein Universe) was originally about 1,200 million light-years. So, when it began to expand, the nebulae near about its boundary must have started with a velocity equal to  $\frac{1}{3}$  of the velocity of light. Hence, at the present moment these nebulae must have a velocity greater than this. This extraordinarily high velocity as well as other difficulties mentioned above throw a reasonable doubt on the theory of expanding Universe, and the cause of the shift of the spectral lines may be looked for elsewhere.

Milne has tried to explain the receding motion of the nebulae by abandoning the notion of curvature and expansion of space and by regarding the observed motions of the distant nebulae as their actual motions in Euclidean space (*Nature*, July 2, 1932). In his distribution-law for the velocities of particles, he permitted a continuous distribution of velocities up to  $c$ , the velocity of light, which does not appear so probable for a particle. The velocity of a nuclear electron is also supposed to have a velocity practically equal to that of light. The same difficulty crops up again, i.e., the mass of the electron as well as of the particle becomes infinite.

Macmillan supposes that there is a leakage of energy from the light quantum or photon in its long journey of millions of years from the distant nebulae due possibly to collisions with other photons, or perhaps to an inherent instability in the photon, so that

frequency diminishes with energy and the spectral lines are shifted towards the red (*Nature*, January 16, 1932). His suggestion deserves more notice than it has so far received. He supposes that the rate of the loss of energy per unit distance from the photon to its total energy is constant, i.e.,  $\frac{1}{\epsilon} \frac{d\epsilon}{dx} = -\alpha$ , where  $\epsilon = h\nu$ ,  $h$  being the Planck's constant,  $\nu$  the frequency and  $\alpha$  a constant. We get ultimately  $\nu = \nu_0 e^{-\alpha x}$ .

His first suggestion that the loss of energy may be due to collisions with other photons is not borne out by any physical evidence; for example, recent experiments on the collision of photons have yielded negative

results, and, moreover, according to Bose statistics it is inherently impossible for two photons to collide.

It is possible that photon may lose energy by passing through intervening gravitational matter, but unless the density of this matter is uniform throughout the whole track of the photon, the above rate for its loss of energy will not remain constant. If mass or energy is not conserved, it is then possible that photon may lose its energy due to some sort of inherent instability, but no physical evidence is yet forthcoming to show if it is actually the case. It seems probable that if this suggestion be worked out, a true explanation of the shift of the spectral lines may be found.

### Letters to the Editor.

#### Yellowing of Sugarcane in the District of Saran in North Bihar.

In the Government Farm at Sepaya, a kind of unhealthiness has been noticed, since 1925, occurring in sugarcane, particularly in the variety Co 213, between the months of July and September during breaks in the monsoon after some heavy showers of rain. This is the time that canes make a rapid growth, but apparently sound plants suddenly show, on the tips of the fourth (or the fifth) leaf, a yellowing which travels rapidly down and affects the whole leaf. The top leaves become pale quickly and the plant ceases to grow. The old roots are found to have decayed and new roots are not formed. The cane remains long in this condition and then withers.

The first signs of distress are seen in canes growing on light soils and in soils having a high concentration of soluble salts the (OH)<sup>-</sup> ion concentration being such as to raise the pH value to 9.0 or higher. The yellowed leaves show a large accumulation of carbohydrates in them, but their nitrogen content is low. Thus a physiological unbalanced C:N ratio sets up. In healthy plants this ratio of carbohydrate to nitrogen does not exceed a third of what is found in unhealthy cases.

Stirring up of the soil followed by irrigation checks the disease, but good and quick results follow the application of nitrogenous or nitrogenous and phosphatic fertilizers and a fresh earthing up. The plants throw up new roots, yellowed leaves turn

green and growth starts again. The cause of the sickness appears to be a deficiency of available nitrogen in the soil due to retarded nitrification just when the growing plants are making a heavy demand on it. Any treatment which quickens the rate of nitrate formation and holds them up to the plants makes the canes recover and grow healthy again.

M. N. GHOSH,

Agricultural Research Institute,

Sabour,

November 6, 1932.

#### The Effect of Low Pressure on the Life of Liquid Drops on the Same Liquid Surface.

THE effect of low pressure on the life of liquid drops on the same liquid surface was studied by means of a bottle of 1 litre capacity fitted with a mercury manometer, a three-way stop cork and a vacuum pump. The primary drops as well as the secondary drops of Boys' soap solutions were formed by means of a burette fixed into the mouth of the bottle, at different pressures of the air inside it. The following results have been arrived at, from the observations taken:—

1. That the life of the floating drops on the same liquid surface depends upon the pressure of the air (or the surrounding medium). The lesser the pressure of the air, the shorter is the life of such drops.

2. That the life comparatively decreases rapidly in the beginning, but slowly afterwards with the decrease of pressure.

3. That the life of such drops remains almost the same for all pressures within the range for which Boyle's law is approximately true.

4. That the formation of such drops becomes impossible when the pressure is reduced to about 5 c.m. mercury column or less.

The above results also confirm the theory of thin layer of air (or cushions) supposed to support the liquid drop on the same liquid surface and many other results obtained by the author in his previous papers.\*

L. D. MAHAJAN.

Physics Laboratory,  
Mohindra College, Patiala, India,  
October 24, 1932.

#### On the Nuclear Spin of Arsenic Atom.

IN a recent note in *Current Science* it was reported by the author that continuing his work on the gross multiplet analysis of the first spectrum of Arsenic, hyperfine structures of all the prominent spark lines in the region 6300-4000A have been analysed and that the structure and intensity of the patterns were interpreted by attributing a spin moment of  $3/2$  to Arsenic. According to Aston's researches Arsenic is single and has consequently got but one type of nucleus. It is therefore particularly suited to the study of hyperfine structure. Tolansky has since published the results of his fine structure measurements on As. II. He based his studies on the unpublished data of K. R. Rao *re. the gross multiplet analysis*. It is surprising to find that the structures of some important lines differ markedly from the results of the writer. The lines 6110, 4888, 4708 have been described by Tolansky as single, showing no trace of structure even with  $2\frac{1}{2}$  millions resolving power. Only, the two lines 6110 and

4708 showed distinct broadenings towards the red. The hyperfine structures were studied by the author, using a quartz L. P. (8 mm.  $\times$  200 mm.) and a glass L.P. (4.8 mm.  $\times$  135 mm.) and fused silica etalons. For photographing the region 6300-5900 Kodak hypersensitive panchromatic plates were used and for the region 5900-5000 Mimosa finogram orthochromatic plates were used. The following table gives the result of the author's analysis for the above lines:—

$\lambda$	$\Delta \nu \times 10^{-3} \times \text{cm}^{-1}$
6110	—309; 285; 200; 0
4888	0 210 650
4708	0 82 150

Fig. 1 is the microphotometric trace of a quartz Lummer pattern of 6110. It will



Fig. 1.

be seen that the line has 2 faint satellites in addition to the strong one at  $\Delta \nu = 200$ . The line 4888 shows a fairly strong satellite at  $\Delta \nu = 650$  while on some plates another faint satellite at  $\Delta \nu = 210$  is also shown.

The line 4370 ( $4p^1\ ^3D_3 - 5p^1\ ^3D_3$ ) has been studied in detail with a view to fix the fine structure intervals of  $4p^1\ ^3D_3$  term and is found to be a group of at least 4 components having the following structure:—

$\Delta \nu \text{ cm}^{-1}$
0.000
0.260
0.485
0.635

This line does not seem to have been studied by Tolansky. He reported, however, fine structure measurements for 4340. During the past few months the author photographed the discharge tube spectrum of Arsenic under different conditions of excitation. The line 4340 was not found in any of the spectra. It is quite possible that the structure given by Tolansky for 4340 is actually for 4370.

\*1. J. B. Seth, C. Anand and L. D. Mahajan, "Liquid Drops on the Same Liquid Surface," *Phil. Mag.*, **1**, 247.

2. L. D. Mahajan, "The Effect of the Surrounding Medium on the Life of the Liquid Drops," *Phil. Mag.*, **10**, 383.

3. L. D. Mahajan, "Liquid Drops on the Same Liquid Surface," *Nature*, **126**, 761; **127**, 70.

4. L. D. Mahajan, "The Effect of the Disturbing Factors and Temperature on the Life of Liquid Drops on the Same Liquid Surface," *Zeitschrift für Physik* (in press).

5. L. D. Mahajan, "Size of the Liquid Drops on the Same Liquid Surface," *Current Science*, **1**, 100.

Taking the known intervals of  $5p^1\ ^3D_2$ , the observed structure of 4370 gives 350, 280

$\lambda$  4370.  $4p^1\ ^3D_3 - 5p^1\ ^3D_2$

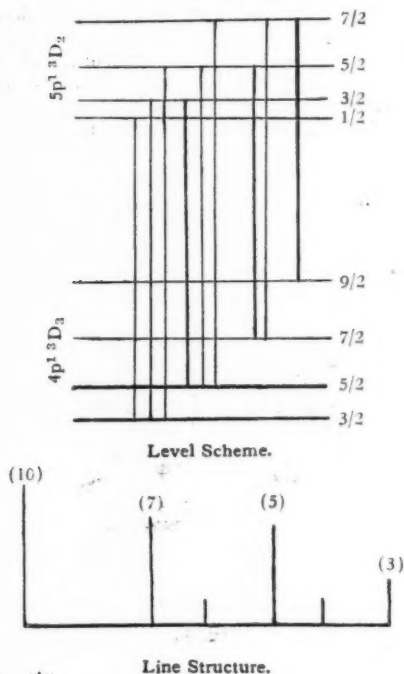


Fig. 2.

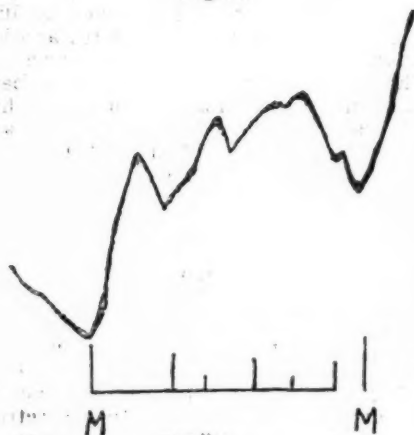


Fig. 3.

and 195 as fine structure intervals of  $4p^1\ ^3D_3$ . The level scheme and line structure are given

in Fig. 2 and the microphotograph of a glass Lummer pattern is given in Fig. 3.

These experiments were carried on on spectroscopic section of the Solar Physics Observatory, Kodaikanal, and a full account of the results will be published elsewhere.

A. S. RAO.

Andhra University,  
Waltair,  
November 5, 1932.

Proc. Roy. Soc., A, 137, 541.

#### On the Breeding-Habits of *Gecko verticillatus*.

ACCORDING to Theobald<sup>1</sup> a female of the species *Gecko verticillatus* lays about eight hard-shelled white eggs, as big as musket-ball cementing them to trees, rocks or secluded cracks in buildings. We made observations of the breeding-habits of these animals both in their natural state and in the laboratory and we found quite a different condition. These creatures lay generally two eggs and sometimes only one but never more than two. They have another peculiarity of laying eggs. Gravid females inhabiting the same locality lay eggs at a particular spot and they generally lay one after another at the same spot, creating a bunch consisting of so many chains of eggs. We reared in our laboratory a number of these creatures in a cage and they laid a number of eggs, each one laying two and some only one, but never any one more than two. A photograph of a chain of eggs in a cage is given here (Fig. 1). At a



Fig. 1.

Part of the cage showing a chain of eggs and a few adult *Gecko verticillatus*.

<sup>1</sup> Gadow, Cambridge Natural History, p. 511, 1923.



particular spot a dozen or more of these could be found. This probably led Theobald to record the reason of his observation as he did. *Gecko verticillatus* generally lays eggs at a particular spot either on trees or on old houses for succeeding years and we are



Fig. 2.

Part of the bunch of old egg shells and a few newly laid ones of *Gecko verticillatus*.

giving a photograph of a part of such a bunch of old egg-shells and a few newly laid ones (Fig. 2).

HIMADRI KUMAR MOOKERJEE.  
GOPI MOHAN DAS.

University College of Science  
and Technology,  
Zoology Department,  
35, Ballygunge Circular Road,  
Calcutta,  
November 4, 1932.

#### On the Morphology of the Vertebral Column of *Rhacophorus maximus*.

BOULENGER<sup>1</sup> has stated with regard to the vertebral column of Anura, that "In those forms in which the vertebrae are procœlous the eighth is biconcave; the ninth being invariably biconvex." Gadow<sup>2</sup> has

<sup>1</sup> Boulenger, *Tailless Batrachia of Europe*, p. 38, 1897.

<sup>2</sup> Gadow, *Amphibia and Reptiles*, p. 20, 1923.

supported the statement of Boulenger. Nicholls,<sup>3</sup> from his study of fifty vertebral columns comprising forty species of *Bufo*, has come to the conclusion that the eighth vertebra in all cases is procœlous and the ninth has a cavity in front and two condyles at the posterior end to articulate with the urostyle. Further, he regards this condition as "apparently diagnostic of the genus *Bufo*". Recently I examined the vertebral column of *Rhacophorus maximus* (Ranidae family) and found that the eighth vertebra is procœlous as in *Bufo* and not biconcave. The transverse processes of the ninth vertebra, however, resemble those of *Rana temporaria*, being directed downwards (Fig. 1).

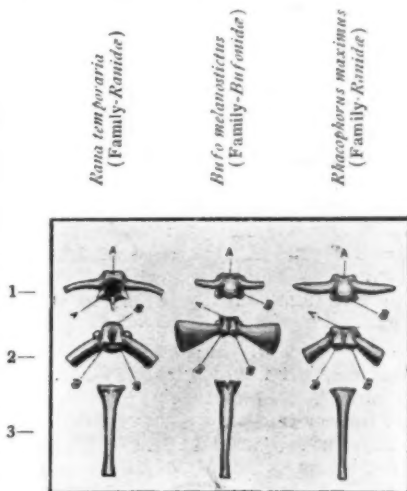


Fig. 1.

A—Socket B—Condyle  
1—8th Vertebrae 2—9th Vertebrae 3—Urostyles

Figure shows the structural peculiarities of 8th, 9th vertebrae and the urostyle of *Rana temporaria*, *Bufo melanostictus* and *Rhacophorus maximus*.

The occurrence of the procœlous condition of the eighth vertebra, which bears the semblance of a character diagnostic in value, in both *Bufo* and *Rhacophorus* as they belong to different families, is highly interesting and whether the same condition exists in other genera is worth consideration before any generalization can be made. Evidently

<sup>3</sup> Nicholls, "On an Apparently Distinctive Character of the Genus *Bufo*," *Nature*, 94, 421, 1914.

Boulenger and Gadow are wrong in making a generalization and the procœlous eighth vertebra is not peculiar to *Bufo* alone.

HIMADRI KUMAR MOOKERJEE.

University College of Science  
and Technology,  
Zoology Department.  
35, Ballygunge Circular Road,  
Calcutta,  
November 7, 1932.

#### Contraction Constants of Enzyme-Substrate Systems.

A DILATOMETRIC study of the enzymic hydrolysis of three glucosides, amygdalin, arbutin and salicin, has been made by means of the dilatometer described before.<sup>1</sup>

The amount of reducing sugar liberated in a given period is proportional to the volume change occurring in the dilatometer. The contraction constant per gram molecule of the glucoside is calculated from the observed depression and the corresponding amount of glucoside hydrolysed.

Emulsin-salicin system gives a contraction constant of 4.10. In the case of emulsin-amygdalin and emulsin-arbutin, however, no volume change could be observed during hydrolysis.

The hydrolyses of the two colloidal polysaccharides, starch and glycogen, by four different diastases, pancreatin, ptyalin, malt diastase and taka-diastase, have also been, separately, investigated in the dilatometer. The contraction constants of these systems are calculated on 100 g. of the substrate.

	Pancreatin	Ptyalin	Malt diastase	Taka- diastase
Starch	0.68	0.67	0.79	1.57
Glycogen	0.45	0.83	0.54	1.47

The constants tabulated above reveal that starch is hydrolysed by pancreatin and ptyalin to very nearly the same extent while malt and taka-diastase carry the reaction to a further stage, taka-diastase effecting the maximum hydrolysis. In the case of glycogen, pancreatin gives the least and taka-diastase the highest depression.

In every case the reaction has been followed by an entirely independent chemical method involving the estimation of the reducing sugars released during the hydrolysis. It is, therefore, possible to correlate

the total depression with the amount of sugar liberated and arrive at another constant which has a relation to a gram molecule of the sugar.

H. B. SREERANGACHAR.  
M. SREENIVASAYA.

Department of Biochemistry,  
Indian Institute of Science,  
Bangalore,  
November 22, 1932.

#### Use of Smear Technique for Chromosome Counts in Rice (*O. sativa*).

N. S. RAO<sup>2</sup> (1929) has determined the diploid number of chromosomes for rice, working with root tips. He states that it was not possible for him to obtain the haploid counts by 'smear preparations' of anthers, although he worked with hundreds of them collected at all hours of the day, and concludes that the reduction division in rice might be taking place some time before sunrise.



Recent work at the Paddy Breeding Station, Coimbatore, has, however, definitely shown that it is possible to make haploid counts of chromosomes in dividing pollen mother cells by using the smear technique. Right kind of buds, which is easily determined by working with progressively younger ones, teased and examined in Aceto-Carmine between the hours of 11-30 and 1 o'clock on bright sunny days showed all stages of first and second divisions. The photograph shows cells with chromosomes in early metaphase, and in one of the cells, the chromosomes are easily counted. Permanent paraffin sections of anthers, fixed during the period, have also

<sup>1</sup> *J. Indian Inst. Sci.*, 15A, 17, 1932.

<sup>2</sup> *Jour. Indian Bot. Soc.*, 8, Nos. 2 and 3.

been found to show all stages of nuclear divisions in pollen mother cells.

K. RAMIAH.

Agricultural Research Institute,  
Lawley Road P.O.,  
Coimbatore.

#### Some Cranial Characteristics of Indian Engystomatidae (Anura).

IN order to establish the exact systematic position of the group Engystomatidae, all the systems of organs from a developmental standpoint and also from the standpoint of comparative anatomy, in the locally occurring three genera, *Cacopus*, *Kaloula* and *Microhyla* are receiving our attention.

The sections of the decalcified heads of the adults of these three genera reveal the following interesting features. The nasal region no doubt exhibits a complicate mechanism, and Gaupp in his 'Anatomie des frosches' (Bd 3, 1904) has described in the frog in detail the dispositions of the elements that go to form the olfactory capsule.

E. O. Lapage<sup>1,2</sup> has described in Urodela and Anura the disposition of the septomaxillary bone and De Villiers<sup>3,4</sup> has also referred to the occurrence of the same bone in the South African forms, *Phrynomerus* and *Cacosternum*. The former author dealing with the Urodela, while emphasizing the cartilaginous origin of the septomaxillary regards the function of the bone to be, for the origin of *musculus dilator naris accessorius*; further where the bone is absent the muscle is also reduced. De Villiers making no reference to this author in his paper on 'Phrynomerus'<sup>3</sup> remarks thus "the septomaxillary may justly be considered as a membrane bone primarily of the lamina superior cristae intermediae, which is its main support." In *Cacopus*, *Microhyla* and *Kaloula* the septomaxillary—an irregularly horse-shoe-shaped bone is situated just in

front of the planum terminale of the cartilago obliqua and I am inclined to believe on the evidence furnished by my preparations of the tadpoles that the bone is of cartilaginous origin. It is no doubt closely attached to the lamina superior cristae intermediae.

In the metamorphosing phase of *Cacopus* prior to its assumption of a terrestrial life, there is an anlage of a single prechoanal sac. Into this sac the two choanae open (Fig. 1).

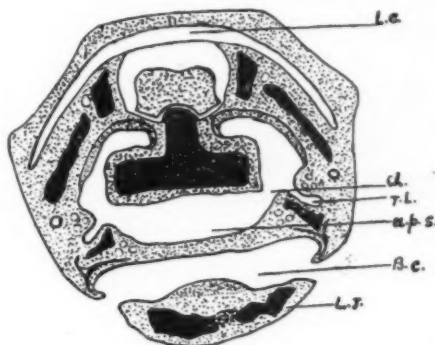


Fig. 1. *Cacopus*.

(camera lucida tracing.)  
obj. 1 × eyepiece 1. Leitz.

- a.p.s. anlage of the prechoanal sac.
- B.c. Buccal cavity.
- ch. Choana.
- L.c. Lymph space.
- L.J. Lower jaw.
- r.l. Lateral recess.

This sac is, however, absent from the other two genera.

In the otic region the common presence of an "extra-plectral" cartilage embedded in the tympanic membrane is observed. Remarkably, however, like their South African congeners, the skin covering this portion of the ear region remains unmodified, giving rise to the oft-quoted phrase "hidden tympanum". So also the incompleteness of the annulus tympanicus. The eustachian tube in *Microhyla* and *Kaloula* is proportionately large for the size of the individual, while it is extremely narrow in *Cacopus*. This point is very well illustrated by Fig. 2. It should also be pointed out that the upper and lower horns of the process basalis and the "transitional" cartilage are reduced in size. The formation of the paraquadrate and the quadratomaxillary will be dealt with later.

<sup>1</sup> E. O. Lapage, "The septomaxillary, 1. In the amphibia urodela," *Journ. Morph.*, **45**, No. 2, 1928.

<sup>2</sup> E. O. Lapage, "The septomaxillary of the Amphibia anura and the Reptilia," *Journ. Morph.*, **48**, No. 2, 1928.

<sup>3</sup> C. G. S. DeVilliers, "On the cranial characters of the South African Brevicipitid, *Phrynomerus bifasciatus*," *Q.J.M.S.*, **73**, Part 4, 1930.

<sup>4</sup> C. G. S. DeVilliers, "The cranial characters of Brevicipitid, *Cacosternum*," *Q.J.M.S.*, **74**, Part 2, 1931.

In *Cacopus*, Devanesan<sup>1</sup> has described in the pharyngeal region a peculiarly modified structure which is glandular in nature as the "pharyngeal organ". In this example the epithelium of this glandular part also furnishes the lining membrane of the eustachian passage. The so-called "pharyngeal organ" is absent, however, from the other two genera and the epithelium lining the eustachian passage is simple.

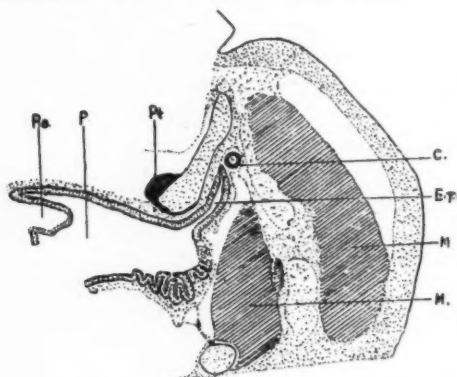


Fig. 2. *Cacopus*.

(camera lucida tracing.)  
obj. 2 X eyepiece 1. Leitz.

- C. Columella.
- E.T. Eustachian tube.
- M. Muscle.
- P. Pharynx.
- P.O. Pharyngeal organ.
- Pt. Portion of pterygoid.

The pars ascendens plectri, a piece of cartilage establishing connection between the crista parotica and pars externa plectri is to be seen only in *Kaloula*.

The operculum is a cup-like cartilage usually associated with a pars interna plectri. The operculum carries a knob in all the three forms for the attachment of the opercular muscle.

The tadpoles of all the three genera are being examined and a detailed paper will be shortly published elsewhere.

L. S. RAMASWAMI.

Department of Zoology,  
Central College, Bangalore,  
December 1, 1932.

<sup>1</sup> D. W. Devanesan, Notes on the anatomy of *Cacopus* systema, *P.Z.S.*, 1922.

### On Thermal Ionisation in Dwarf Stars.

IN recent years, Chandrasekhar, Majumdar and Kothari and Milne<sup>2</sup>, have deduced generalized formulae for stellar ionisation for the degenerate and relativistic cases. Chandrasekhar and others, however, conclude that stellar matter in dwarf stars is not ionised at all, a result in direct contradiction to the assumptions of Fowler, Stoner and others<sup>3</sup>. The author has recently deduced the following expressions for thermal ionisation:—

$$\ln \frac{n}{n_+} = \frac{x}{KT} + \frac{4.453 \times n^{2/3}}{10^6 \times T} - \frac{T \times 1.845 \times 10^{10}}{n^{2/3}} \quad (1)$$

(Non-relativistic, electrons degenerate.)

$$\frac{n+n_-}{n} = 8\pi \left( \frac{KT}{hc} \right)^3 e^{-x/KT} \dots \dots \dots (2)$$

(Relativistic, non-degenerate.)

$$\ln \frac{n}{n_+} = \frac{x}{KT} + \frac{hc}{KT} \left( \frac{3}{4\pi} \right)^{1/3} n_-^{1/3} - \frac{\pi^2 KT}{3 hc} \left( \frac{4\pi}{3} \right)^{1/3} / n_-^{1/3} \quad (3)$$

(Relativistic, electrons degenerate.)

where  $n$ ,  $n_+$  and  $n_-$  are the number of neutral atoms, ions and electrons per unit volume. These agree in form with the expressions of previous authors. Now Chandrasekhar and others consider that the number of electrons is identical with the number of molecules of stellar matter, as calculated from astrophysical data for dwarf stars and take this to be of the order of  $10^{30}$ . By using this value of  $n_-$  in their equations they obtain zero degree ionisation. But the number of molecules obtained from observed data should really be equal to the sum of those of the neutral atoms, ions and electrons taken together. For the simple case of hydrogen if  $x$  be the degree of ionisation and  $N$  the total number of particles per unit volume, we have  $n = \frac{1-x}{1+x} \cdot N$ ,

$n_- = \frac{x}{1+x} \cdot N = n_+$ . Substituting  $N = 10^{30}$  in the above equations, and solving graphically, it is found that complete ionisation is attained well within a temperature of  $5 \times 10^3$  °C. For complex elements, since

<sup>2</sup> Chandrasekhar, *Phil. Mag.*, **9**, 292, 1930; *Monthly Notes of Roy. Soc.*, **91**, 446, 1931.

Majumdar and Kothari, *Z. Phys.*, **61**, 712, 1930; Milne, *Monthly Notes of Roy. Soc.*, **90**, 53, 1930.

<sup>3</sup> Fowler, *Monthly Notes of Roy. Soc.*, **87**, 114, 1926.

Stoner, *Phil. Mag.*, **7**, 63, 1929; **9**, 944, 1930.

Eddington, *Monthly Notes of Roy. Soc.*, **92**, 471, 1932.



ionisation may take place in more than one stage, the calculation of the degrees of ionisation becomes more difficult, but even in these cases the degrees of ionisation vary with temperature and are expected to approach unity within a temperature  $10^{10}$  °C. Considering the abundance of hydrogen in stars, and for stars having high central density and temperature (dwarf stars and even ordinary stars according to Milne's model<sup>1</sup>), it is concluded that stellar matter is completely ionised, thus justifying the assumptions of Fowler and others.

A. GANGULI.

Chemical Laboratory,  
College Duplex,  
Chandernagore,  
November 22, 1932.

#### Some Peculiarities in the Gametophyte of *Adiantum capillus-veneris* L.

THE study of the gametophyte of *Adiantum capillus-veneris* by the writer has brought to light a number of interesting peculiarities which it seems desirable to place on record.

Pure cultures of the gametophyte were raised from spores sown on sterilized soil. The spores are tetrahedral with only two coats and burst at the tri-radiate mark during germination. The filamentous stage is short, limited to a single cell, or sometimes 2-3 cells long. The flattening of the gametophyte begins rather early even at the second cell stage. The course of development is similar to that in *Pteris biaurita* and *Ceropteris calamitanos* (as found by the writer of which the data are not yet published) and by Goebel for *Pteris longifolia* (Goebel, *Organography of Plants*, Eng. Ed., p. 203). A spatula-shaped prothallus is first formed by the division of the cells by walls at right angles to the horizontal surface. A second lobe emerges later anew from the anterior lateral region. The two lobes are thus unequal to begin with but on account of the greater growth of the younger lobe, the prothallus ultimately becomes heart-shaped. The thickness of the cushion is variable being dependent on the age of the prothallus. The gametophyte is massive in structure. A few cases of once or twice dichotomously divided prothalli have been observed.

Collenchymatous thickenings on the cell walls of the wings characteristic of the

gametophytes of *Cheilanthes farinosa*, *Adiantum caudatum* and *Polystichum auriculatum* (as found by the writer, the data of which are not yet published) are entirely absent in the present case. Dr. Horvart has described similar thickenings in the gametophytes of *Notholana*, *Cheilanthes* and *Adiantum cuneatum* (quoted Bower: *Filicales*, 3, pp. 80, 96) belonging to the Gymnogrammoid Series. Such thickenings are also known to occur in the gametophytes of *Lygodium*, *Mohria* and *Anemia* belonging to Schizeaceae (Bower: *Filicales*, 3, p. 96). In discussing the relationship of the latter with Gymnogrammoid Ferns, Bower has referred to the significance of such thickenings in the members of the two groups and a phyletic value seems to have been attached to these. The absence of such thickenings in the gametophyte of *Adiantum capillus-veneris*—a Gymnogrammoid Fern—and its presence in *Polystichum auriculatum*, a member of the Dryopteroid Series which has no affinities either with Gymnogrammoidea or with Schizeaceae throws doubt on regarding it as a character of phylogenetic value. It seems likely that these thickenings develop independently in the prothalli of the species restricted to dry environments as adaptations to ecologic conditions.

The gametophyte is monœcious and the sex organs usually occur interspersed on the cushion on the under surface. The antheridia are frequently found on the upper surface particularly in young prothalli in rather feeble light. Only in one case, however, an archegonium was found on the upper surface of a mature prothallus at the cushion region behind the notch.

The development and structure of the antheridium is, as usual for Leptosporangiate ferns. Some primitive types of antheridia with the cap-cell divided by one or two walls have been observed besides the normal ones. The number of sperm mother cells per antheridium varies a great deal, from 32 in the median vertical section (usual for primitive ferns) to 16 characteristic of the advanced Leptosporangiates, on the same prothallus. The gametophyte is thus peculiar in combining the features of the prothallia of primitive as well as advanced ferns. Besides, a few cases of embedded antheridia have been observed alongside the normal ones on apparently quite healthy prothallia. Such antheridia are unusual in the Leptosporangiate ferns. The dehiscence

<sup>1</sup> Milne, *Monthly Notes of Roy. Soc.*, 91, 4, 1931.

of the antheridium follows that described by Schlumberger for *Woodsia ilvensis*. The opercular cell is thrown out bodily. The sperms show  $2\frac{1}{2}$  coil with the beak slightly notched at the apex. The structure and development of archegonium is as usual for the Leptosporangiates. Only in one case three instead of the usual 2 free nuclei in the neck canal were observed.

The embryogeny has not been studied. Three, and occasionally four, sporelings have been observed growing from a vigorously growing prothallus.

The chromosomes are cylindrical elongated.

PRAN NATH MEHRA.

Lahore,

November 24, 1932.

#### The Magnetic Properties of Nickel Colloids.

RECENT work<sup>1</sup> has shown that the diamagnetism of bismuth colloid depends on the size of the particle. It was felt that an extension of the work to ferro and para magnetic metals would be of interest. Accordingly, some preliminary work has been done with nickel.

Nickel colloid was prepared by the method of the intermittent current arc from an induction coil, the sparking being arranged between two nickel electrodes in normal propyl alcohol. The colloidal powders were obtained by settling or by centrifuging. Finally the powders were obtained in small bulbs and sealed. The whole work was done in vacuum so that there was no chance of the particles getting oxidised.

The values of the intensities of magnetization of the powders were determined by the Curie method in a constant field strength of about 4,500 gauss, the necessary precautions being taken.

It was found that the intensities of magnetization of the colloidal powders were in all cases less than that of pure nickel, the values in these experiments varying from 70 to 85% of mass value.

Attention may be drawn to the work of Montgomery<sup>2</sup>, who working with nickel colloidal suspensions gets similar discrepancies.

Further information regarding the magnetic properties of the nickel colloids in

relation to particle sizes is being obtained and the detailed results will be published elsewhere.

S. RAMACHANDRA RAO.

Annamalai University,

Annamalainagar,

November 28, 1932.

#### On a Fossiliferous Quartzite from the Trichinopoly Cretaceous.

IN the course of our study of the flints and cherts associated with the upper beds of the Trichinopoly Cretaceous area, we have come across a fossiliferous quartzite which we think is a very unusual type of rock. We have pointed out elsewhere that all the flints and cherts of this area are the result of silicification of original organic limestones, and have recently announced the discovery of numerous algae in several sections of these rocks. Under the microscope these flints and cherts are, as a rule, seen to be almost entirely composed of crypto-crystalline silica. An exceptional type of silicification is the one represented by the fossiliferous quartzites now under study. Many of these quartzites are gray in colour and are more or less fine-grained; sometimes they are quite white and granular, presenting the typical saccharoidal appearance. The rock is highly fossiliferous, the organic structures—corals, and the casts of lamellibranchs and gastropods—being easily recognizable, even in hand specimens. Under the micro-



Quartzite—showing corals.

About  $1/5$  natural size.

scope, all the sections show a typical mosaic aggregate of quartz grains, thus revealing the true quartzitic nature of the rock. A remarkable feature of these quartzites is that they also reveal broad patches of algae, mostly *Lithothamnion*. Very frequently the entire algal patch seems to be shattered and the details of the structure more or less obliterated. Now and again, however, we see the algal structures sufficiently clear to admit of easy identification, as such. A few foraminiferal sections, chiefly of the family Miliolidae, are also seen here and there. Under cross nicols these algal patches, foraminiferal shell sections and coral sections are all seen to be uniformly resolved

<sup>1</sup> For details and references to previous work, see S. R. Rao, *Ind. Jour. Phys.*, **7**, 35, 1932.

<sup>2</sup> C. G. Montgomery, *Phys. Rev.*, **39**, 163, 1932.

into a mosaic of quartz gains showing that it is a true case of a quartzite derived from the silicification of a fossiliferous rock. A fossiliferous quartzite of this nature is an unusually interesting type of rock. Dr. Lees in his paper on the Chert Beds of Palestine (*Proc. Geo. Assn.*, 39, Pt. 4, 1928) has mentioned a similar rock type which he describes as follows:—"In some places an unusual quartzite bed outcrops interbedded with Cenomanian limestones. It is intensely white in colour and has a sugary surface texture. Mr. G. S. Blake showed me some definite, though indeterminate, fossil shapes in this quartzite which aroused suspicion as to its real nature. A thin section shows nothing but a regular mosaic of quartz crystals. Several opaque patches suggest some organic structure." Obviously Dr. Lees is here speaking of a rock very similar both in nature and origin to the type that we are now describing; but whereas the fossil shapes he has seen are "indeterminate" and "suspicious", those in our type are absolutely clear and convincing.

L. RAMA RAO.

C. PRASANNAKUMAR.

Dept. of Geology,  
Central College, Bangalore,  
November 19, 1932.

#### Some Physiological Investigations of Fern Prothalli under Cultural Conditions.

AN investigation of the behaviour of the prothalli of some Polypodiaceæ (*Anisogonium esculentum* Ptesl., *Pteris longifolia* L., *Goniopteris prolifera* Roxb., *Nephrodium molle* Desv.) under various physiological conditions has been carried on by the writer for some time and has produced some interesting results. In one set of cultures placed in a corner of the glass-house in which the prothalli were submerged under water, a large number of filamentous outgrowths were observed from the surface and marginal cells of the prothalli after one month. The filaments are septate, branched apparently similar to the filaments of some algæ. They grow towards the direction of light. The length of the cells in different filaments or even in the same filament is very variable. The cells formed in the light of very low intensity are much longer, narrower and with a small number of chlorophyll grains as compared with the others formed in the light of comparatively higher intensity. Usually in the same filament, the cells at

the base are much longer as compared with the cells in the upper region where they become relatively more favourably placed with respect to light.

The possible factors which could have been effective in bringing about this filamentous response in flat prothalli, under the conditions in which the cultures were placed could be:

- (1) Submerged condition as such;
- (2) Abundance of free moisture;
- (3) Feeble light.

These three factors have been isolated one by one and their effect studied. Prothalli submerged under water (supplied with nutrition) and those floated over it in the same culture have both produced such filaments, so that the submerged condition does not seem to be an influencing factor. In another experiment some flat prothalli were placed in feeble light on soil and frequently watered so that the soil remained muddy while some more were placed in identical conditions alongside except that they were given just the amount of water that would keep them living, to act as controls. After two months the prothalli of the first culture produced large number of filaments while those acting as controls kept to their normal shape. Abundance of free water is therefore one of the causal factors. In the third experiment prothalli growing on soil were supplied with abundance of water so that the soil remained muddy throughout. One of the cultures was placed in rather feeble light and another in open day-light. After 3 months there was an abundance of filament formation in the former while in the latter the usual form of the gametophyte was retained. It seems obvious, therefore, that feeble light in conjunction with abundance of free moisture is responsible for bringing about the filamentous condition—the one alone being without any result.

Bearing these results in mind, the writer next tried the gametophytes of *Adiantum lunulatum* Burm., an apogamous fern that usually develops tracheids in the general body of the prothallus. The normal form of the prothallus is cordate. Submerged under water and placed in feeble light the development of the tracheids is stopped in the tissue of the gametophyte. The prothalli lose their usual cordate form and during further growth become strap-shaped. Quite long ribbons one layer of cell in thickness and sometimes branching laterally

have thus been produced. They bear a close resemblance in form to the prothalli of *Hymenophyllum*. If the prothalli are kept under these abnormal conditions still longer, the straps become filamentous in their further growth. Such filaments may also be given off laterally from the straps and are algalike in habit resembling in a general way the prothalli usually described in the genus *Trichomanes*.

It has thus been possible under the influence of feeble light and abundance of moisture to convert an ordinary cordate type of prothallus first to the strap-shaped type characteristic of *Hymenophyllum* and later to the filamentous type characteristic of

*Trichomanes*. It is possible that the types of the prothalli in these two species have been produced by progressive stages of reduction (in the way described above) from the ancestral cordate type under the influence of the above factors which prevail in the habitats to which these species have adapted themselves.

Another conclusion arrived at is, that submerged condition as such has a great retarding influence on the formation of sex organs on the prothalli.

PRAN NATH MEHRA.

Lahore,  
November 23, 1932.

### Research Notes.

#### Certain Pathological Effects of Ultra-Violet Radiation on Mosquito Larvæ and Pupæ.

[Malcolm MacGregor. *P.R.S.*, Ser. B., 112, 774.]

THE effect of ultra-violet wave band upon the larvæ and pupæ has been studied and an attempt has been made experimentally to determine the wave length of radiations and to ascertain the histological and pathological nature of the injury sustained. It has been shown that the radiation causes a form of injury fatal to the insects. 'Paralysis' is generally noticeable within 48 hours after an exposure of 45 seconds from a quartz-mercury vapour lamp held at a distance of  $11\frac{1}{2}$  inches from the larvæ. Larvæ at all stages of development are susceptible to injury and death from exposure to ultra-violet radiation. Pupæ are considerably less susceptible and are increasingly resistant.

Paralysis is symptomatic of an histological injury. Histolysis is of a progressive type affecting cells subjected to irritation. Adjacent cells are also affected. The rate of induction of the tissue changes is directly proportional to the duration of irradiation.

The paper describes the details of the histological nature of the injury.

#### The Esclangon Effect and the Effect observed by Miller.

IN *Comptes Rendus*, 195, p. 769, 1932, M. E. Carvallo has given an interesting note on the possible identity of the effect observ-

ed by Miller and that noted by Esclangon. It is well known that the theory of relativity was based on the null result of the Michelson-Morley experiment. Many other experiments designed to detect the relative motion between the earth and the ether have also given negative results. But Miller, working in Cleveland and on Mount Wilson, found a positive effect; the result of his experiments created a sensation in scientific circles since it contradicted the theory of relativity. The magnitude of the effect was, however, too small to be attributed to the orbital motion of the earth through the ether. The fact that the effect was maximum when the observing telescope pointed in a north-westerly direction was also against such an explanation. Miller concluded that his results indicated a relative motion between the solar system and stellar space. Now Esclangon has shown (*Journal des Observateurs*, 11, iv, p. 49, 1928) that a ray of light reflected by a mirror which is being carried along by the earth in its motion will be slightly deflected. M. Carvallo remarks that this follows from Huyghens' construction and that the effect should be a maximum when the direction of the earth's motion is inclined at  $45^\circ$  to the axis of the observing telescope in the arrangement of Michelson and Morley. This is found to be the case in Miller's experiment, whereas the displacement of fringes due to a difference of path should be a maximum when the velocity of the earth is parallel or perpendicular to the observing telescope. Hence M. Carvallo concludes that the effect observed by Miller is identical with the Esclangon effect, unless these



minute effects are both illusory. As he points out in conclusion the truth will be known when the experiments of these investigators are performed with greater precision.

#### Petrography of Pacific Lavas.

IN recent numbers of the *American Journal of Science* (XXI, 377 and 491, 1931) F. W. Barth has published an interesting paper on the "Mineralogical Petrography of Pacific Lavas". The rock-forming minerals of these lavas have been studied chemically and optically. New chemical and mineralogical data for these minerals bearing on the important question of rock differentiation are given. By the use of optical analyses in conjunction with chemical analyses, it has been shown by the author that the sequence of crystallization is parallel to the sequence of differentiation and thus it follows that the theory of crystal setting is adequate to explain the differentiation of Pacific lavas.

#### Separation of a Gaseous Mixture of Isotopes.

IN *Zeitschrift für Physik*, 79, 108, 1932, G. Hertz describes a very interesting experiment designed to separate the isotopes of an element in the gaseous state. Previous attempts by Aston and by Harkins and his collaborators had resulted only in the production of a mixture in which the proportion of one of the isotopes had been slightly increased. The improved apparatus of Hertz on the other hand has enabled him to separate the isotopes in an element like neon almost completely. The method employed was the same in principle as that employed by previous workers, namely, to utilize the difference in the rates of diffusion of the components of a mixture of isotopes. The improvement consists in modifying the apparatus so as to be able to use a series of separating units together, each of which has the property of separating a continuous stream of the mixture of isotopes passing through it into two equal streams having a different composition from the incoming gas. Each separating unit consists of two tubes having porous walls, the inlet tube of one being connected by a side tube to the side outlet of the other while the direct inlet tube with porous sides continues in a straight line through both. In this arrangement the mixture of isotopes enters at the inlet of the first tube; the lighter component diffuses through the walls faster than

the heavier component and is pumped out at the side-outlet of the first tube. The heavier part goes through the inlet of the second tube, but, since after diffusing out through the side outlet of this tube its composition is not altered much, it is led back to the inlet of the first tube. Then it again goes through both the tubes so that the stream coming out of the outlet of the second tube is rich in the heavier component while the stream coming out of the side outlet of the first tube is rich in the lighter component. This stream passes through the pump of the first separating unit into the inlet of the first tube of the second unit and from the side outlet of the same to the pump of the second unit and so on till from the pump of the last unit it collects in a vessel  $V_1$ . The heavier part going through the direct tubes courses in the opposite direction and collects in a vessel  $V_n$  connected to the inlet of the first unit. The disposition of apparatus is clearly shown by a number of diagrams in the paper. Hertz used first of all an apparatus with four units to separate a mixture of helium and neon and then set up an arrangement consisting of 24 units in two parallel series of 12 units each. The diffusion pumps were automatically controlled as regards the heating current of gas and cooling current of water according to the method described by W. Pupp (*Phys. Zeit.*, 33, 530, 1932). The diffusion tubes were made by the Steatit-Magnesia A.-G. out of a fine chamotte rich in kaolin. When first a mixture of neon and helium was introduced, the vessel  $V_n$  was of 30 litres while  $V_1$  was of 5 litres. All the helium collected in  $V_1$ . After removing the helium, the 30-litre vessel was used as  $V_1$  and a vessel of 400 c.c. as  $V_n$ . The gas in  $V_n$  was taken out for testing after the apparatus had been worked for 8 hours. It was found that with the above sizes equilibrium was established in about 4 hours. In order to get a sample rich in the lighter component, the two vessels were interchanged. The various specimens were examined with a mass-spectrograph giving Thomson parabolas and also with a Fabry-Perot Etalon for fine structure. The intensity of the parabolas as well as the hyperfine structure components served to give the ratio of the two isotopes of neon. In a specimen rich in  $Ne_{20}$  the component due to  $Ne_{22}$  was absent while the two components were equally strong in a mixture having equal proportions

of  $\text{Ne}_{20}$  and  $\text{Ne}_{22}$ . When  $\text{Ne}_{22}$  was in excess the component due to it was stronger, thus showing that the percentage isotopic constitution of ordinary neon can be obtained from the ratio of the intensities of the hyperfine structure components of neon lines. In the mass spectrogram of the specimen rich in the heavier isotopes, there was a parabola corresponding to  $\text{Ne}_{22}$  besides the one due to  $\text{Ne}_{21}$ . This method seems to be promising of important results with a wide range of application including such cases as nitrogen and hydrogen where one of the isotopes is present in an extremely high proportion.

#### Hidden Geological Structures.

"THE limitations of ground water as aid in determination of hidden geologic structure" forms the theme of a paper by E. K. Soper published in a recent volume of the *Bulletin of the American Association of Petroleum Technologists*, XVI, 1932. The author points out that in these localities where the surface of the land is relatively flat without, therefore, giving any clue to the underlying structures, irregularities of the water-table, such as wide flat terraces, sharply defined artesian areas, or anticlinal bulges may be reliable indicators of the existence and location of buried structures.

#### Breeding of the Field Mouse.

[J. R. Barker and R. M. Ranson. *P.R.S.*, Ser. B, 112, 774, 39, 1932.]

IN the second part of their contributions, the authors describe further experiments on the effects of light on the reproduction of the field mouse. The mice are subjected to summer conditions of temperature and food but are exposed to light for only 9 hours daily. The authors call this "the winter light experiment". In addition, mice are subjected to 15 hours of exposure to light from a 60 watt bulb and given summer food but kept at a low temperature. This experiment is called "winter temperature experiment". Under the conditions of the "winter food experiment" the mice are subjected to exposure of 15 hours of electric light and summer temperature. The animals are fed on hay, rye grass seed and a small amount of growing grass. While the control mice consumed 30 grms. of growing grass per day with no hay and grass seed, the experimental mice were given about 3 grms. of hay and

1½ grms. of growing grass and an unlimited supply of grass seed.

The results of these experiments show that under the conditions of the "winter temperature experiment" the field mouse breeds less at low temperatures (5°C.) than at summer. The fecundity of the males is not affected. The cutting down of fresh food to a minimum does not hinder reproduction.

#### The Influence of the Visible and Ultra-Violet Rays on the Stability of Protoplasm.

UNDER this title W. W. Lepeschkin has recently published an interesting paper second of the series. (*American Journal of Botany*, July 1932.) The author states that protoplasm subjected to the action of strong light is gradually disintegrated and dies. Further, the protoplasm is specially sensitive to ultra-violet rays. The cause for the destruction lies in a chemical change of protoplasmic proteins as shown by the works of Henri, Cleaves, Clark and Young. Two kinds of cells were used in the experiments by the author: yeast cells and leaf cells of *Elodea canadensis*. The poisons used are alcohol and iodine and the resistance of living matter to these after exposure to light was investigated. The decrease of the stability of living matter produced by the direct sunlight disappears soon in diffuse light on account of the synthetic processes of the cell restoring the substances changed by light. This process is very rapid in the yeast cells. If the synthetic processes are depressed by alcohol, the stability of protoplasm decreases further. Among the visible rays of the sunlight, green, blue and violet rays are more effective than red rays in producing the decrease of the stability. Ultra-violet rays produce an increase of the stability of living matter, the maximum being reached quickly according to the strength of radiation. If the radiation is prolonged or if it is strong, the stability of protoplasm is decreased as in the visible rays.

#### Algal Limestones from Queensland.

PROF. H. C. RICHARDS and Dr. W. H. Bryan of the Department of Geology, University of Queensland, have recently published a paper (*Geological Magazine*, No. 817, July 1932) dealing with an interesting discovery near Gigoomgan, Queensland, of a large mass of limestone made up almost

entirely of the microscopic remains of algae. The age of the rock is proved to be Permian-Carboniferous on other palaeontological evidences. According to the authors the features of outstanding interest in the Gigoongan limestone are: (i) the great size of the mass, (ii) the purely algal character and uniformity, (iii) the absence of dolomiti-

sation, and (iv) the absence of associated oolites. The authors consider that the comparatively poor development of reef building corals at the time of the formation of this limestone, as compared with the present day, may have been an important negative factor contributing towards the purity of the algal reef.

### Some Correlations between Skull and Brain.

THE Second David Farrier Lecture\* on this subject by the eminent Dutch Anthropologist, Dr. Ariëns Kappers, forms a fitting sequence to the first, delivered by Sir Charles Sherrington. And while Sherrington dealt with the fascinating problems of the Physiology of the Brain, Kappers tends to emphasize the enormous importance of its morphology, especially from an anthropological point of view. There is probably no more fascinating subject in Anthropology than the relation between the morphological peculiarities of the Brain and the racial characters of the Skull. Indeed, an elucidation of this problem opens up a new and wide vista of understanding of the varied races of humanity. While, however, due to a large number of material and scientific difficulties, the author does not claim to present a solution to this problem, he endeavours to lay out certain lines along which the solution may be sought for. This relation between the Brain and the Skull is of deeper importance than it may at first suggest, for, while the Skull and the Brain are closely correlated regarding differences in form, the brain but reflects its intrinsic cerebral varieties.

It is interesting to see that in its turn the skull-form profoundly modifies the brain-form. This occurs in many fishes, birds and mammals. In Teleostomes, for instance, a flattening of the head in the larval stages has given rise to a compression of the brain resulting in a gradual obliteration of the ventricle of the Fore-brain by the formation of a solid mass of cells on its dorsal surface known as the Epistriatum. The cerebellum has become more compact and its cavity is almost entirely absent, while the fourth ventricle is very narrow. The same thing is found in birds also, where, due to a large quantity of brain material and the limited

space that is at its disposal, all the ventricles have either become greatly reduced as in the majority of birds or are entirely absent as in parrots.

The correlations between the brain and the skull in mammals are of another type, where the body size also is responsible for the brain size. If two related species of mammals differ in size, the brain of the larger animal has the smallest length-breadth index. Again if two related species of mammals differ in cephalization coefficient, the brain with the largest coefficient has the greatest length-breadth index. An examination of a large number of related genera of marsupials, rodents, ungulates, carnivores and primates, shows, that body size remaining the same, in lesser cephalised animals the brain is more elongated, while in higher cephalised ones it is rounder. These changes in the brain form and size are not without effect on the pattern of fissuration. It has not been sufficiently realized in all cases that higher cephalization goes hand in hand with more arched and perpendicular fissuration. Comparing the brains of the dog and the bear, it is noticed that the arcuate and the coronolateral fissures are pronouncedly arched in the bear, whose cephalization coefficient is nearly twice that of the dog. The submergence and the consequent obliteration of some of the fissures from external view are only necessary results of this intense arching of the brain.

An extension of these researches into a comparison of new-born and adult mammals of the same species has resulted in establishing a relation between the actual brain weight of a foetus or a young animal and the brain weight it should have if it were an adult of its size. By these calculations it is seen that, while in some animals like the pig and the lion the body-brain weight relation in the young is higher than in the adult, in chimpanzee and man, it is not so; in fact

\* *Phil. Trans. Roy. Soc. of London, Ser. B.*, 221, B. 480.

the cephalization in these two is considerably less than in the adult. Kappers' own observations show that even in the first year, the relative brain weight of the child is less than it would be if it were an adult of the same size. This is probably why the brain of human fetuses and new-born ones is rather long, and while the rolandic, sylvian and parietal-occipital angles are larger, the stem angle is smaller than in the adult.

The relation between the adult human skull and brain is very intimate and Kappers draws certain important conclusions as a result of his examination of a large number of skulls and brains of both Brachycephalic and Dolichocephalic types. In the first instance, his intimate and expert knowledge of these two types of skulls amongst the Dutch has led him to conclude that Brachycephalic brains have large sylvian and rolandic angles correlated with a deeper temporal lobe and a pronounced superior temporal convolution. Another feature of the Brachycephalics is the high and vertical crescent-shaped lunatic sulcus, a fundamentally simian feature. In all these and other minor points the Dolichocephalics are different.

But it is really a comparison of the skulls and brains of the different human races that is of utmost interest. Based as it is on a personal examination of a large number of well-fixed brains, the statements made by Kappers are as precise as they are authoritative. Beginning with Armenians, a hyperbrachycephalic, hypsicephalic race, one is struck at once by the large sylvian angle, a deep temporal lobe and an extremely curved superior temporal convolution,—all correlated with the peculiar occipital shortening of the Armenian skull. The Lebanese brain is similar to the Armenian but the Adnan Arab brain is different from either, in both cephalic index and fissuration. A straight sylvia, a small sylvian angle and a straight superior temporal are the main characteristics of the long-headed brains of the Egyptians and the Soudanese. Poynter and Keegan have described similar relations for the brains of American Negroes, Hrdlicka and Spitzka for Eskimos and Flashman Duckworth and Woodward for Australians.

From an anthropological point of view the Mongol races are very interesting. There are two groups to be recognized, the Brachy-platycephalic Northern Mongols and the Meso-hypsicephalic Chinese. The brain weight of the former seems to be very high compared with their stature which is smaller than that of Russians whose brain weight, however, is not so high. The frontal flatness of the skull has brought about a frequent interruption of the inferior temporal fissure and deep temporal fissures in the occipital region. The Chinese brain which is primarily interesting on account of its height has been examined by a large number of workers including the author who think that in the smaller stem angle and the higher callosum index it resembles the brachy-hypsicephalic Dutch brain. Indeed, in certain other features like the steep hippocampus and the vertical crescent-like lunatic sulcus the Chinese brain is so intensely brachycephalic that it has often been said to resemble the brain of the Orangutan and attempts have even been made to trace the origin of the Mongol race from this anthropoid. The Japanese skull, however, is less mesocephalic than the Chinese and its sylvian angle is larger. An examination of the brain of Bataks shows that it is just possible that in this race the female brain tends to be more brachycephalic than the male.

While so far we have been dealing with the features that are intimately correlated with the racial types of the skull, there seem to be others, especially in the fissural arrangement that do not show this correlation with the skull type. Most important amongst these are the posterior rhinal sulcus, the anterior branches of the sylvia and the lunatic sulcus. While for any type of generalization, an examination of a large number of skulls and brains is necessary, this much may be said with certainty, that the breaking up of a fissural pattern, originally simple, is a direct result of an extension of function and an examination of man, both extinct and present, reveals a progressive development of certain regions of the brain, more especially the inferior frontal, which is the speech centre,—his greatest and most special distinction.

B. R. S.



## Convocation Addresses.

## University of Nagpur.

SIR S. RADHAKRISHNAN'S address to the graduates of Nagpur University presents a vivid picture of current social, economic and political problems which are reviewed with a sympathy and breadth of vision which characterise an eminent philosopher. The new spirit and temper animating the minds of young men is due to the emphasis on the application of science to the practical problems of human affairs and to the consciousness of social solidarity. Reference is made to Mr. Lakaminarayan's munificent bequest of forty lakhs of rupees, but the terms of the bequest and the scheme for its utilization are, in our opinion, to be carefully examined before adopting them, for there is a great deal of false glamour about starting technological institutes in the Universities for the purpose of training young men for commercial and industrial careers. Sir Radhakrishnan hopes that the proposals of the committee appointed by the University to devise schemes for the proper utilization of the donation, will give a fresh impetus to the industries of the country. We have no copy of the report at our disposal and we can only trust that the committee has not embraced the common error of suggesting technological courses being associated with a purely academic training such as a University can impart. The preparation of young men for practical careers implies training in workshops, business methods, the art of salesmanship, management of concerns large or small, skill in advertisement, marketing the productions, trade relations, foreign currency and exchange and quite a host of other matters which will make the careers profitable. Sir Radhakrishnan points out that the chief cause of unemployment in India is due to a want of application of scientific methods to agriculture and industries. The greater part of the address is devoted to an examination of the unemployment problem in India which is expected to be solved to some extent by the Government pursuing a policy of progressive industrialization. A brief summary of the statistics dealing with the percentage of population depending on agriculture and industries in the different countries is given to show that the dependence of Indians on the precarious produce from the land accounts for the greater part of the unemployment of her people. There seems to be

a little fallacy in arguments based on a comparative study of statistics. Have countries like Britain and the United States which are industrialized almost to the teeth, solved their own unemployment problem? What is the percentage of the unemployed to the total population in these countries? Is it quite clear that agricultural pursuits lead directly to unemployment? The employment of machinery on a progressive scale must necessarily diminish the employment in the number of human hands in industrial organizations and if we add to this, mass production, and increasing birthrate, we have the correct picture of the problem. The theory that industrialization of a country will safeguard it against unemployment has to be examined closely with reference to other contributory causes. Speaking about the progress of civilization, Sir Radhakrishnan is reported to have said that the possibilities of the abuse of science are great and may not add to its enrichment; and "the inspiring vision of the reign of justice and fairplay on earth" such as poets and philosophers are capable of dreaming are also dreamt of by the scientists. One of the functions of science is to discover the properties of matter and the power of using or abusing them is not the attribute of the scientist. Recent advances in nuclear physics and experimental biology have given us new qualitative values which, with those derived from researches in philosophy, ought to make definite contributions to the progress of humanity. Dealing with other topics of current interest Sir Radhakrishnan points out that political emancipation alone is powerless to eradicate the many social evils from which India suffers and lays emphasis on what he calls "mental freedom" to be placed within the reach of those who are affected by social injustice. Political equality as a working hypothesis can be sustained only if opportunities for self-improvement exist in the whole community. He mentions that religion is opposed to freedom of enquiry and entrenching behind authority which is not to be questioned, it has produced misfortunes for humanity. Religion is alleged to be opposed to "Eugenic sterilization" and the practice of contraceptive methods and "social hygiene" and the removal of untouchability. We conceive the true function of religion to be to provide for the human mind a discipline of truth and to

establish an eternal communion between man and his Maker. It is essentially an affair of the heart and not of the head. Troubles arise where the latter is involved. Referring to the troubles of the present time, he is of the opinion that the greatest need is a radical readjustment of fundamental ideas, and he further points out that we have to imbibe the spirit and methods of Western scientific research and not necessarily, its results. This is a subject which requires a very careful examination especially in view of the fact that the results of the modern scientific investigations have affected every detail of our daily existence. We have no hesitation in saying that this thoughtful address provides a most useful and stimulating reading.

A.N.R.

#### Agra University.

In the federal type of the University of Agra, Sir Sitharam sees a great advantage of providing for a large body of poor young men aspiring for the humanising and vitalising influences of higher learning which on account of distance and other reasons will be otherwise denied to them. Judging from the number of graduates and under-graduates in the Universities of the United Provinces, he makes out a strong case for the establishment of new Universities and the consolidation of the existing ones. He pleads for the establishment of tutorial system in the Universities and his suggestions deserve careful and immediate consideration of the authorities. Most Universities have taken steps to provide for the periodical inspection of the residential quarters of their students not living in the University or College Hostels and for a general sort of supervision over their work and other activities. But this procedure requires to be systematised into a regular feature of tutorial control as an indispensable part of University work.

L.S.R.

#### Andhra University.

Dewan Bahadur M. Ramachandra Rao alludes in his address to the institution of the University Training Corps for Andhra Desha. We recognize the need of military training for our young men provided the necessary funds for its organization in the University should be forthcoming. Few will question the excellent educational

results, such as, cheerfulness of obedience, a sense of stern discipline, a strong spirit of comradeship, resourcefulness, teamwork and self-sacrifice which a camp life will promote. Nothing is better calculated to foster the excellent qualities of true citizenship.

L.S.R.

#### Allahabad University.

The retiring Vice-Chancellor, Dr. Gangadhar Jha, dealt in his address with the curtailment of Government grants which must necessarily impose serious handicap on the continuance of existing arrangements and their expansions in the University. It is true that more money is required for the diffusion of Elementary and High School Education in the country, but this money is not to be obtained by pinching the University grants. If we expand the lower grades of instruction, it follows that the University education also should keep pace with it. India needs every form and grade of education in a far greater measure than has been possible for the Government and the people to provide for her. His ideal of higher learning is unimpeachable. He says, "Our function mainly is to provide the country with a set of highly cultured young men who will go forth into the world and improve the level of society. Our ideal, so far, has been high culture and not money-making."

L.S.R.

#### Lucknow University.

Perhaps the most important portion of Mr. C. Y. Chintamani's address is that which relates to discipline, a subject which is in need, to-day, of some emphasis. He sums up the lesson of discipline in these words, the message of which is important both to the elderly citizens and the youth of the country. "Consciousness of one's limitations and of the necessity of constant self-examination and of learning from others, obedience and loyalty to the leaders, discrimination between judgment and conscience so that deference may be paid to the views of more experienced men instead of an ignorant conception of 'conscience' being made the excuse for thoughtless action based on wrong judgment, the preservation of our heritage of humility and reverence without prejudice to our readiness to act boldly on our own responsibility even if everyone

go against us when our conception of duty dictates such a course—in my humble view all these qualities are connoted by and included in the single yet comprehensive word 'discipline'. No harm is done if a few more substantives like 'self-sacrifice', 'service', 'tolerance' and so forth are thrown in to make the definition applicable to every form of human emotions and will. Mr. Chintamani is not satisfied with the qualities possessed by the graduates of our Universities. He says that when a graduate of average ability goes forth into the world the public have a right to expect that he possesses a certain amount of knowledge and a few other qualities without which one can do no satisfactory work in any line. He asks if this expectation is fulfilled and requires an answer from the University. From the way he puts his question, one will not be wrong in inferring that Mr. Chintamani suspects that the expectation is belied and this is a terrible indictment of the work of the Universities.

M.S.M.

## Patna University.

Sir Courtney Torrel in his address to the graduates complains against the introspective character of the Indian mind which needs correction by a wider and deeper infusion of objective sciences than is attempted in the Universities at present. "The Indian mind must no longer be directed inwards to

contemplate the soul alone, but outwards to observe and react to the external world." There is a great deal of philosophical abstraction about the Indian mind which delights in logical sophistry and this is due to the spiritual ideals which dominate the Indian life. A corrective is necessary and we must say that the Indian student of average intellect will readily adapt himself and profit by scientific training. We are not quite convinced if the exhortation of Sir Courtney Torrel to subject all favourite theory and beliefs to the ruthless test of practical experiment is at all a practicable and desirable suggestion. If some of the more valued spiritual possessions of our race were subjected to the stern experimental tests of science,—they may not be amenable to them,—what will be the repercussions on our social systems and ethical code, if the conclusions of such scientific enquiry were to prove that the articles of faith now held by mankind have no scientific sanction. We do not believe that it was the intention of His Lordship to suggest to the young men of Patna that they should re-examine and analyse the fundamental concepts of right and wrong by the application of scientific methods; rather we take it that it was an advice on the lines of St. Paul "Prove all things and hold fast to that which is good," and a plea for the cultivation of the faculty of observation.

M.S.M.

## Science News.

A GOOD Tibetan Dictionary, embodying the results of modern researches in the fields of Tibetan linguistics and philology, has long been a great desideratum. Such a Dictionary has now been undertaken by the Himalayan Research Institute of Roerich Museum. The new Dictionary includes, besides the material found in the already existing Tibetan Dictionaries, published in European languages, the rich material found in numerous lexicographical works issued in Tibet, China and Mongolia, and up to now unexplored by Western Science. Besides the above printed material, the compilers will add a vast material collected by them in the course of their researches, and which will be published here for the first time. The Dictionary will contain the Sanskrit equivalents of important terms: loan-words, which will be traced to their origins wherever possible, and an extensive material from the colloquial language, and the various living dialects of Tibet. It is hoped to bring the Dictionary to completion towards 1934.

The following papers were read or taken as read at a meeting of the U.P. Academy of Sciences, held on October 28th, 1932:—

- 1. "On Two Species of the Genus *Cephalogonimus* Poirier from Water-Tortoises of Allahabad with remarks on the family *Cephalogonimidae* Nicoll." By Bindeshri Prasad Pande, Esq., M.Sc., Zoology Department, Allahabad University.
- 2. "A Note on the Expanding Universe." By Prof. A. C. Banerji, M.A., M.Sc., F.R.A.S., I.E.S., Mathematics Department, Allahabad University.
- 3. "On Some Experiments with Iodine Vapour." By G. R. Toshniwal, Esq., M.Sc., Physics Department, Allahabad University.
- 4. "Ageing of Ferric Phosphate and Vanadium pentoxide Sols at various Temperatures." By Dr. Satyeshwar Ghosh, D.Sc., and Mr. S. N. Banerji, Chemistry Department, Allahabad University.
- 5. "On the Absorption Spectra of Alkyl Halides." By Prabhat Kumar Sen Gupta,

Esq., M.Sc., Physics Department, Allahabad University.

"On the (i) Virtual Independence of the Reverberation Period in Architectural Acoustics of the Auditorium Volume, and (ii) its Dependence on Sound Frequency." By Satyendra Nath Ray, Esq., M.Sc., Lecturer, Physics Department, Lucknow University, Lucknow.

"On the Equation of State of Saturated Vapour." By Messrs. Brij Bhushan Kak and Sushil Kumar Ghosh, Physics Department, Lucknow University, Lucknow.

"On the Relation between Energy Current incident on an Auditorium Wall and Gauss's Theorem." By Satyendra Nath Ray, Esq., M.Sc., Lecturer, Physics Department, Lucknow University.

"On the Formula for the Locus of Discontinuities in the Isothermals of Brombenzol." By Gopal Das Kshetrapal, Esq., Physics Department, Lucknow University, Lucknow.

In a letter addressed to us Dr. H. Chaudhuri writes:—"In the course of my address as President of the Botany Section of the Nineteenth Indian Science Congress, held at Bangalore in January last, I expressed the view that 'with the increase in mycological work, the establishment of an Indian Bureau of Mycology has become an imperative necessity'. Since then I have consulted many mycological workers in this country and they all favour the idea. The *Madras Agricultural Journal* of February 1932 fully endorsed my views and suggested the establishment of a combined Bureau of Mycology and Entomology. To quote the *Journal*, 'To start with a combined Bureau of Entomology and Mycology, would, in our opinion, meet the immediate needs of the day, facilitate research in these sciences and prevent unnecessary duplication of work in different centres.' This Bureau will be of immense help to mycological workers and if a combined Bureau is established, to entomological workers also. Like the 'Centraal-bureau voor schimmelcultures,' Baarn, it shall maintain a culture station and take up the work now done for us as a matter of grace by the Imperial Mycological Institute, Imperial Entomological Bureau and similar bodies in Europe. As these are not maintained for the benefit of the Indian workers and as they are very busy bodies, it takes months and even years may pass by before a report on any material sent to them, is received. If such a Bureau is established it will save much valuable time and money for India. Perhaps many workers in India are not aware of the fact that India contributes towards the maintenance of many of those bodies, and the subsidy already paid or promised by the I.A.R.C. to them exceeds Rs. 2,75,000. It may be a privilege to be associated with those bodies with such high reputation, but one has unfortunately to admit that the money we spend is certainly not commensurate with the benefit derived by India. If the amount had been spent in establishing such an Institute in India, it would have been of lasting benefit to her. I would strongly suggest that the Imperial Agricultural Research Council should immediately form a sub-committee to go into the matter and advise the Council regarding the details of the scheme. Such an Institute will no

doubt have financial support from Provincial Governments as well."

In commemoration of the Seventieth Birthday of Sir P. C. Ray, the Founder, the Foundation-President and a Patron of the Indian Chemical Society, a Jubilee Volume is being published by the Society, containing contributions from many eminent chemists in India and abroad.

The volume will cover about 350 pages. Price for Fellows Rs. 3, and for Non-Fellows Rs. 5.

The order for supply of the volume to be sent to the Hon. Secretary, Indian Chemical Society, P.O. Box 10857, Calcutta.

Under the auspices of the Society of Biological Chemists, India, Mr. M. J. Narasimhan, Mycologist to the Government of Mysore, read a paper on "Cytoplasmic Inclusions in Spike Disease of Sandal" on 2nd November 1932. The transmissibility of the spike disease of sandal by grafting or budding is at present the only evidence for claiming that it is of the nature of a virus disease. In the tissues of spiked sandal were observed intra-cellular inclusions in close association with the nuclei similar to those reported in some of the plant virus diseases such as the mosaic disease of tobacco, the rosette of wheat, and the Fiji of sugarcane and in some of the animal virus diseases such as rabies, and fowl-pox. Particularly interesting was the fact that the inclusions in spiked sandal reacted to the same staining reaction that was claimed by Goodpasture, to be characteristic of the inclusions of fowl-pox. The nature of the inclusions was also discussed. The presence of cytoplasmic inclusions in spiked sandal is a definite evidence of the virus nature of the sandal spike disease.

At the ordinary monthly meeting of the Asiatic Society of Bengal held on the 7th November the following papers were read:—

1. DR. S. L. HORA.—*Buchanan's Ichthyological Manuscript entitled Piscium Bengalae Inferioris Delineationes.*

Dr. Hora described a hitherto unknown Manuscript by Dr. Francis Buchanan, entitled *Piscium Bengalae Inferioris Delineationes Septuaginta octo*, presented to the Asiatic Society of Bengal by Mr. Gilbert P. Whitley, Ichthyologist at the Australian Museum.

After stating Buchanan's early interest in the fishes of the Ganges and the interruption of his investigations, further particulars concerning Buchanan's fish drawings were given. A list of species with vernacular names and references to published accounts in the 'Gangetic Fishes,' was also presented.

2. DR. S. L. HORA AND D. D. MUKERJEE.—*Further Notes on Hamilton-Buchanan's Cyprinus Chagunio.*

It is well known that at the time of his departure from India in 1815, Buchanan was deprived of the drawings of fishes made during the Survey period at the Government's expense. Consequently, some of his species that are not illustrated in the 'Gangetic Fishes' are loosely defined and are difficult to determine. *Cyprinus chagunio* is a species of this nature. Considerable controversy raged between Günther Day regarding the specific validity of this species. The precise systematic position of *C. chagunio* was indicated



by one of the authors in 1928, and it was pointed out that *Barbus beavani* Gunther had to be relegated to the synonymy of *B. chagunio*. Messrs. G. E. Shaw and E. O. Shebbeare's collection from the rivers of Northern Bengal has shown that *B. spilopholus* McClelland, a species characterised by the prolongation of the posterior rays of the anal fin and by the well-marked tubercular pads on the head, represents the males of *Barbus chagunio*. It is now clear that both *B. beavani* and *B. spilopholus* are synonyms of *B. chagunio*. A few remarks were made on the Sex Ratio in this species.

3. B. SAHNI AND A. R. RAO.—*On Some Jurassic Plants from the Rajmahal Hills*.

The paper dealt with collections made by parties from the Lucknow University during the years 1927, 1931 and 1932. The fossils described come from eight different localities, all in northern part of the Rajmahal Hills.

Several of the fossils belong to new species, but as some of them are only small fragments, names have been assigned only to three. The known species are only described or figured in so far as our specimens extend our previous knowledge.

A description of the localities with table showing distribution of species, Equisetales, Filicales, Cycadophyta, Coniferales, Incertae, was given.

4. V. NARAYANASWAMI.—*Additional information concerning the Provenance of the Plants constituting the Malayan Collections of Sir George King, Hermann Kunstler, Father Benedetto Scortechini and Leonard Wray, being a Supplement to Sir George King's 'Materials for a Flora of the Malayan Peninsula' and Mr. H. N. Ridley's 'Flora of the Malayan Peninsula'*.

If Mr. Ridley's 'Flora of the Malayan Peninsula', published in five volumes between 1922 and

1925, be examined, it will be seen that a great many of the species described from materials laying in the Calcutta Herbarium are imperfectly localised. Nor were the exact localities given of the plants described by Sir George King and his helpers in the 'Materials for a Flora of the Malayan Peninsula'. Yet in regard to rare plants, exact localities are necessary and, to meet the need, the author has drawn up this compilation at the suggestion of Mr. I. H. Burkill, at one time of the Asiatic Society of Bengal, and afterwards Director of the Botanical Garden at Singapore.

After the papers were read DR. JOHAN VAN MANEN made a communication on *A new translation of the Gita Govinda*. Dr. B. Faddegon, Professor of Sanskrit in the University of Amsterdam, well known on account of his elaborate monograph on the Vaicesika-system, has published a translation of the *Gita Govinda* in Dutch. The translation is of considerable scholarly as well as poetical interest. A thoughtful introduction suggests some valuable explanations with the help of the psycho-analytic method.

We acknowledge with thanks the receipt of the following:—

"Nature," Vol. 130, Nos. 3285-3288.

"Chemical Age," Vol. 27, Nos. 694-697.

Report of the Zoological Survey of India for 1929-32.

"The Indian Forester," Vol. 58, No. 11, Nov. 1932.

"The Journal of the Indian Mathematical Society," Vol. 19, No. 10.

"Journal of the Bombay Natural History Society," Vol. 36, No. 1, November 1932.

"Scientific Notes of the Indian Meteorological Department."

## Reviews.

GEOFYSISKE PUBLIKASJONER, Vol. IX, No. 9. *Exploration de quelques perturbations atmospheriques a l'aide de sondages rapproches dans le temps*. By J. Bjerknes (Oslo: Det Norske Videnskaps-Akademi, 1932.)

Dr. J. Bjerknes' recent memoir on the investigation of some European atmospheric disturbances with the aid of successive soundings of the atmosphere carried out from Ucele in Belgium will doubtless rank as a classic of meteorological literature. The study is based on two sets of registering balloon ascents, the first set comprising 25 soundings in the period 26, 27 and 28th December 1928, and the second 7 soundings on 29-30th March of the same year. The soundings were made under the direction of Mons. Jaumotte, Director of the Royal Meteorological Institute of Belgium with instruments devised by him, and many of the balloons penetrated well up into the stratosphere.

The idea that "weather" is caused by perturbations of the atmosphere involving large-scale movements of air masses with a meridional component of motion and the consequent coming together of "air-masses" with differing temperatures and moisture-contents is no doubt old, but at the present day it has acquired a new definiteness and precision, thanks largely to the work of the Norwegian school of meteorologists. The feature of distinction of the present study from previous studies on the same subject lies in the greater fullness with which the properties of "air-masses" and of the associated "fronts" are followed out not only at the surface, but also in the free atmosphere up to the tropopause. Many points of detail about temperature and humidity distribution in height, which were hitherto either matters of theory or only supported by scattered observations, are now brought out lucidly and in a connected manner

with a definite individual series of disturbances.

The first of the series of ascents treated in this memoir reveals the story of a primary cyclone which moved in an approximately west-to-east direction across Scandinavia on the 26th December and of a secondary cyclone which followed it across Belgium on the 28th. Dr. Bjerknes shows that the whole sequence of phenomena was due to the eastward movement of a tongue of "cold" or "polar" air-mass whose maximum thickness over Uccle reached 5 km. and whose horizontal west-to-east extension was about 2000 km. The vertical section of the advancing and receding sides of the cold air-mass have shapes suggestive of the head and tail of the longitudinal section of an aerofoil. An interesting explanation is given of the continuous precipitation which occurred at Uccle before the arrival of the advancing or "aggressive cold wedge" as being due to the generation of a vortex of warm air in front of the advancing cold air, thus forming an obstacle for the rest of the inflowing warm moist air. This explanation is supported by the lines of flow of air which he has drawn identifying them with lines of equal entropy. As far as the writer is aware, this is the first occasion when isentropics, based on observation, have been presented in connection with a definite atmospheric disturbance.

Dr. Bjerknes has also shown that although the maximum thickness of cold air was only 5 km. over Uccle, further north-east, it extended right up to the tropopause.

It is well known that the height and temperature of the tropopause vary normally from about 17 km. and  $-80^{\circ}\text{C}$  over the equator to 8 km. and  $-50^{\circ}\text{C}$  over a latitude of  $75^{\circ}$ . These values are only average, and there are considerable day-to-day variations which are much more marked in temperate than in tropical latitudes. As a result of statistical studies, notably by Schedler in Germany, it had been established that a rise of the tropopause in temperate latitudes corresponded to conditions more tropical than those normal to the latitudes while a fall of the tropopause represented more polar conditions. Dr. Bjerknes has now shown that this result is true not only as an average but is also true of changes connected with individual cyclones. Similarly, the high positive correlation between the height of the tropopause and the pressure at 9 km. which had been established statistically by Dines is

shown to be true of individual disturbances. Dr. Bjerknes has also pointed out the close physical connection between the perturbations of the tropopause and those that occur in the lower layers of the atmosphere.

It is not possible, in a short review, to summarise the many new points of view, or the old points of view presented in a more illuminating manner contained in this memoir. The thanks of all students of the Physics of the Atmosphere are due to Dr. Bjerknes for this classical piece of work and to Mons. Jaumotte for the series of soundings which made it possible.

K. R. RAMANATHAN.

*A Naturalist in the Guiana Forest.* By Major R. W. G. Hingston. 16 plates and 150 illustrations. 18s. net. (Edward Arnold & Co., London, 1932.)

Here is a fascinating story of a teeming and fantastic insect world in which camouflage and mimicry, as protective devices, are practised with an artistry seemingly beyond even the most adroit efforts of man. Major Hingston opens up a world stranger than any yet revealed in fiction, the marvels of which are told with the skill of a Fabre. Here you may read of the association of spiders into a community and of their association with ants: the spiders constructing communal hammocks—one come upon was as tall as a man and able to hold a child—in which ants build their nests, with eggs, larvæ and pupæ complete. These ants, in return for the hammock-accommodation, protect the spiders by taking a vigorous offensive when the hammock is disturbed and the spiders escape to safety.

You may also read of butterflies with false heads; of caterpillars which mimic snakes and are provided with poison spines; of a certain species of *Laternaria* whose heads are prolonged into a thick shovel-shaped beak on which are modelled the features of an alligator; and of Cicadas which squirt with force a fluid at their enemies. Again, you may read of ants which make bridges by linking themselves to each other; of termites on foraging expeditions; and of a battle royal between ants and termites.

This book is a narrative of the experiences and observation of the expedition, of which Major Hingston (whose biological work in India is so well known) was the leader, organized and despatched to British Guiana by the Oxford University Exploration Club

three years ago. Its purpose was to study the fauna and flora of the equatorial rain-forest, but its main objective was to learn something of the teeming life in the forest roof, a dense green canopy through which sun and rain can hardly penetrate.

The book is in two parts. Part I describes in detail the life and doings of the expedition, and contains information concerning a number of practical matters which may be of use to any future party following the trail blazed by Major Hingston and the members of the expedition. Part II is devoted to records of detailed observations made in a forest described as "remarkably luxuriant, fully equal to that of the Amazon, and exceeding in splendour the Asiatic forests, where the great trees are taller, the tangle of bush-ropes more profuse and spectacular, and the crowding of epiphytes on the stems and branches more riotous in their diversity and confusion." *A Naturalist in British Guiana* certainly takes its place with the other classics of biological exploration and observation, and will be eagerly read by those whose interests in biology extend beyond the limits of laboratory study.

H.E.R.

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*Tables of Cubic Crystal Structures of Elements and Compounds.* By I. E. Knaggs,

Ph.D. & B. Karlik, Ph.D. (Adam Hilger, Ltd., London.)

It is now almost axiomatic that X-rays serve as a powerful weapon in the study of Crystal Structure. In addition to the pioneer work of the Braggs, so much literature has accumulated on the subject of X-ray crystallography within the last twenty years that "the average researcher," says Sir William Bragg in his foreword, "will no doubt feel some satisfaction in realizing that long searches by many workers have been rolled into one, and that they (the authors) have earned the gratitude of those whose labour they have saved."

In addition to the principal data for a large number of crystals, a very extensive list of references—complete up to August 1931—is added. The usefulness of this work in this field can hardly be overestimated. "Crystal Structures in order of spacing" is the heading of another list which the authors claim to be immensely useful with the "Hilger Crystallograph" and interpretative chart.

Dr. C. F. Elam, the metallurgical specialist, has further enhanced the value of this book by contributing a corresponding set of tables dealing with alloys.

P.S.

### Coming Events.

#### Indian Science Congress.

##### 20TH SESSION.

Patna, 2nd—7th January, 1933.

#### Society of Biological Chemists (India).

##### 2ND ANNUAL BUSINESS MEETING.

Government Medical College, Patna, 3rd January, 1933 (2-30 P.M.).

#### University of Madras.

##### EXTENSION LECTURES.

5th January 1933.

"Ancient South Indian Policy and its bearing on our Present Problems", by Dr. S. Krishnaswami Iyengar, M.A., Ph.D.

12th January 1933.

"Trade Union Movement in India", by Mr. P. S. Loganathan.

19th January 1933.

"Agricultural Improvement in Madras", by Mr. S. V. Ramamurti, I.C.S.

26th January 1933.

"Co-operative Movement in the Madras Presidency—Its Achievements and Failures", by Mr. D. N. Strathie, I.C.S.

30th January 1933.

"Poor Relief in Other Lands", by Miss T. Joseph.

6th February 1933.

"The Problem of the Indian States", by Mr. M. Ramachandra Rao.

10th February 1933.

"Federal Finance, the Main Problem", by Dr. P. J. Thomas, M.A., Ph.D.

13th February 1933.

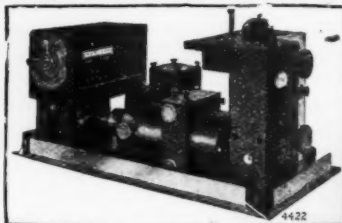
"The Emergence of the State", by Mr. M. Rathnaswami, C.I.E.

17th February 1933.

"Disarmament", by Mr. J. Franco.

20th February 1933.

"Political Economy was the States' Master in the Nineteenth Century, while in the Twentieth it became its Slave", by Fr. Bassenach.



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